THE GLASS INDUSTRY

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THE FLOOR OF HEAVEN

The Definition of Glass

By DR. FRANK W. PRESTON

καὶ ἐνώπιον τοῦ θρόνου ὡς θάλασσα ὑαλίνη ὁμοία κρυστάλλῳ

Rev. 4. 6.

καὶ εἶδον ὡς θάλασσαν ὑαλίνην μεμιγμένην πυρὶ καὶ τοὺς νικῶντας.....ἑστῶτας ἐπὶ τὴν θάλασσαν τὴν ὑαλίνην, ἔχοντας κιθάρας τοῦ Θεοῦ καὶ ᾄδουσιν τὴν ᾠδὴν Μωϋσέως

Rev. 15: 2—3.

"And in front of the throne there is what resembles a sea of glass, crystal-clear like ice; And I saw this thing which resembles a sea of glass mixed with fire, and the victors standing upon the glassy sea, with the guitars of God in their hands; and they sing the song of Moses."*

The word "glass" is an ancient one, and of good repute, but of poor definition. It is used by the most reputable of authors, including St. Paul and St. John the Divine, so that its significance might almost be ascertained on divine authority. And many others have used the term throughout the ages, in the English language, and in other languages, and their right to use it has rarely been gainsaid, though they have used it to mean almost anything, and almost everything.

The question therefore, "What is glass?", cannot be answered, because it cannot be asked. The question itself is meaningless, a tale told by an idiot, signifying nothing. It is a Humpty-Dumpty word, and means whatever the speaker wants it to mean.

Therefore, I have refused in times past to testify as to its meaning, because it has all possible meanings, including many exactly opposite meanings, and, all things considered, it is a very fine word that should not be spoilt by being defined.

If it is decided that it must be spoiled, any definition should state the purpose thereof, and the limits within which the definition is expected to hold; for there can be no comprehensive or all-including definition. We might proceed as follows:

"For George Morey's purpose, and for the purpose of certain other physical chemists, glass is an undercooled liquid (at room temperature, or some other temperature hereafter to be defined): but since not all undercooled liquids are glasses, (e.g. undercooled water is not usually so considered) page George Morey if you have an undercooled liquid and want to know if it is a glass."

"For the purposes of B. E. Warren and them that sport with x-rays, glass is a higgledy-piggledy arrangement of atoms, in which the coordination number requirements are taken care of, but the atoms are not 'arrayed'."

"For simple souls like myself, glass is a product of the glassmaker's art; if it is a substance made largely of sand, smelted in a furnace of some 2000° to 3000° F., calling for tizeurs (teasers), and after cooling down is a brittle substance most economically cut up by glaziers, wielding diamonds or glazier's wheels; or if, while not necessarily or usually so cut, it can be so cut, then it is glass. The behavior of the thing toward the glazier's wheel is, in fact, perhaps the best discriminant as to whether a thing is glass or not."

"From the point of view of Law, or of Commerce, glass is an artificial product (there is no trade in 'natural glass'), sold to the public and represented to

be hard (five or six on Mohs' scale), durable, and fire resistant. Unless some qualifying adjective is used, it contains volumetrically, and usually by weight, more than 50% silica; it will not char, or burn; it will not fuse at less than a red heat; and it is made by fusion in a high-temperature furnace."

These are definitions of a product or article; they are not definitions of a *word*. The word "glass," and the adjective "glassy," and the corresponding words in other languages from ancient Egyptian down to the present day, have many other meanings. These meanings are legitimate, in that a man is trying to say something for his hearer's or reader's benefit; he is often using the word in a more or less metaphorical sense, but he is trying conscientiously to give the right impression, to explain things in a way his listener will understand.

When applied to a *product*, especially to a product which the discourser hath an interest in selling, and when he coveteth the greater gain by describing as glass some thing which conventionally is not glass, then is the use of the term illegitimate, improper, and deceitful. Such foul use of a noble term proceedeth from the mouths of caitiffs, rapscallions, and knaves; and it shall nought avail them that saints have described as "glass" that which may turn out to be a Heavenly Plastic or polymerized resin.

I return now to Saint John, and what he said nigh nineteen hundred years ago. The authorized version of the English Bible does not give too good a rendering of John's Greek: I have ventured to try to improve it. It is a convenient and happy quotation, since the words "glass" and "crystal" both occur in it, and neither of them has anything like its present meaning, certainly nothing like its present *technical* meaning. To help matters out, the word "sea" also occurs, twice, and it does not mean sea, as is perfectly obvious, since the victors stand on it.

The English, authorized, translation says, "there was a sea of glass." What John says is, "(there is) *as it were* a sea of transparent stone" (hyaline), in other words, a vast expanse of shining polished floor, like the vast shimmering sunset sea that stretches west from Patmos. John several times uses the word "sea" to express the idea of a vast space, and perhaps once or twice to mean "space" in its scientific sense.

The transparent stone (hyaline) is apparently a material used in Egypt in certain coffins for mummies. The word itself is Egyptian. By the time of Pliny, Egyptian glass had apparently reached a stage of transparency that warranted its being called hyaline. * * So John does not warrant that the floor of heaven is vitreous, that its atoms are higgledy-piggledy, or that it is in danger of devitrifying when Morey gets there. It is merely hard, shiny, transparent (or at least highly translucent), and vast in extent.

". . . . a vast expanse of polished floor, like unto crystal." The Greek word is crystallos, but crystallos means primarily clear ice, and secondarily, rock-crystal or quartz. Ice and quartz are often vastly clearer and more transparent than ancient glasses, or even our modern glasses, and what John is saying is, that the floor of heaven is more brilliant, purer and clearer than mummy-coffin material, carefully selected though this may have been. * * *

Thus John in a simple short sentence uses the words "sea," "glass," and "crystal," in senses far removed from their modern technological, legal, or commercial significance; and I have no fault to find with him, or with others, who, struggling to express the inexpressible, follow his example and do the best they can.

It is only when deceit, and the lure of lucre, enter in, that departures from modern exactness become reprehensible or inadmissible.

Before we turn from St. John to St. Paul, it might be noted that John uses the word "glass" twice in Revelation, and each time in the same phrase ("a sea of glass, as it were"), and each time the word is *hyaline*. This necessarily reminds our later generation of the French "Mer de Glacé" or Ice-Sea, upon Mount Blanc. And here it is worth noting that whereas, in English, glass and ice are two different words, and cannot be exchanged at all, in French, "Glacé" means first, clear ice, and then clear polished-plate glass. In Greek, it is crystal and ice that are confused, in French it is ice and (plate) glass.

From the purely human angle, it is not difficult, I think, to see the picture that John was painting. The aged Saint in his exile had seen the summer sun go down across a tideless, waveless, shimmering sea. The most splendid moment was when the sun's disk had cut the horizon, and a broad highway of light stretched from the cliffs of Patmos to the setting sun. There is no more impressive scene in nature than such a sunset.

The blazing sun upon the horizon is the effulgent throne of God; the vast expanse of sea "clear as ice" yet "mixed with fire" (the pathway to the sun) is a fitting floor of heaven. Solidified to glass, it will support the saints, many of them already dead at the hands of Roman sadists and Jewish fanatics. Perhaps some fire-edged western clouds suggested by their wierd outlines the strange beasts of the apocalypse: after two thousand years people still trace such images in the sunset clouds.

A minute or two passes: the sun is disappearing fast: in the gloaming the sea becomes in fact the floor of heaven. Upon its vast expanse is standing a countless multitude of saints and John is no longer alone; they are not silent ghosts, no pale wraiths of the past, but the troubadours of heaven, a victorious host, facing the throne, and to the accompaniment of their singing guitars, they raise the Battle Hymn of the Republic. "I will sing unto Jehovah, for he hath triumphed gloriously," the paean that Moses composed some sixteen hundred years before, the Song of Redemption, when the quicksands of the Red Sea were safely past, and the pursuing tyrants overwhelmed.

We turn to St. Paul: I Corinthians 13, 12: 2 Corinthians 3, 18. (We see as in a glass, darkly.)

Paul is not speaking of hyaline, but of a mirror, a very imperfect mirror, made of speculum metal, probably tarnished, and certainly far from flat. The word is "eisopter," or "catoper," a thing you "look into," or "look down on" (for the purpose of seeing a reflection). There is no glass involved: the modern equivalent would be a piece of tin-plate, that ignoble, poisonous, and imperfectly-reflecting competitor of glass. Paul

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THE JOHNNY BULL . . .

trail blazer in bottle making machinery

The transition from hand blown bottles to fully automatic machine made bottles included a period when so-called "semi-automatic" machines were used. Therefore, from our present viewpoint, some of these semi-automatic machines appear very crude to us today and we are liable to overlook their value to glass manufacturers at the time they were in use. One of the most successful of these semi-automatic machines, temporarily at least, was that known as the "Johnny Bull."

The Johnny Bull Bottle Machine acquired its nickname from the fact that it was invented and first used in England. It was also known in the United States as the "English Machine" and the "United Machine." First marketed in England by the P. B. M. Syndicate, Ltd., whose corporate title probably stood for Pierpont Bottle Machine Syndicate, it was claimed in that country that the "Johnny Bull" was the first machine to make large narrow neck bottles on a successful commercial basis.

The bottle making machinery situation in England at the time the Johnny Bull Machine was introduced can be briefly outlined, based on a letter dated January 18, 1908 from Edward Evans & Company, consulting engineers and patent agents. The viewpoint of the Evans company can be stated about as follows.

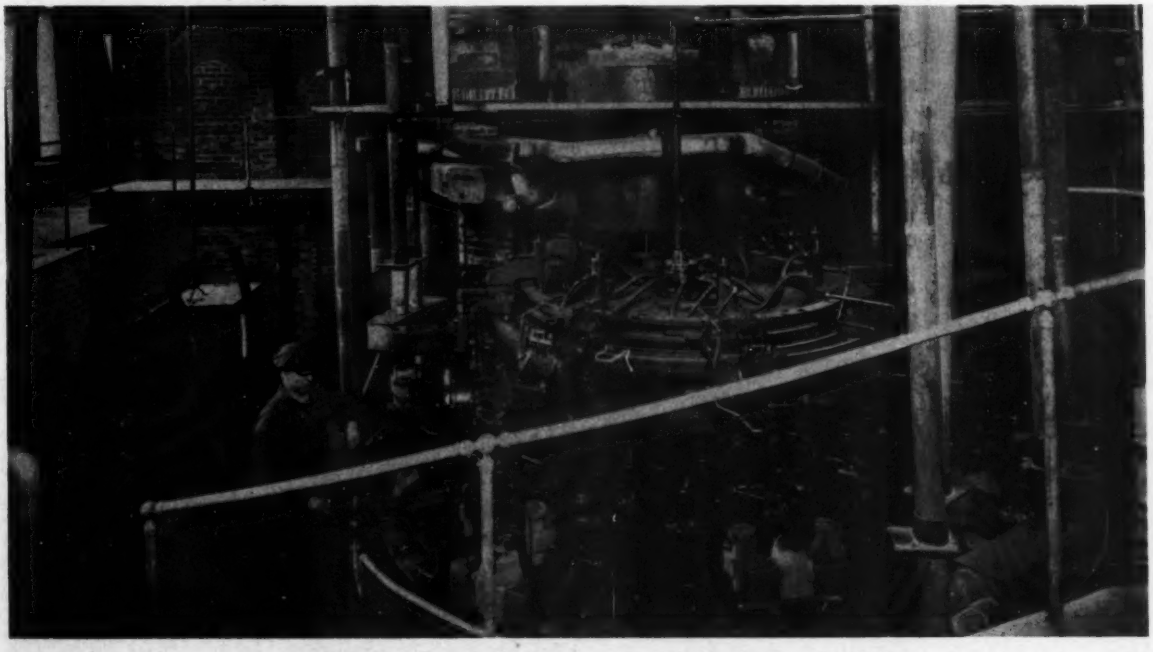
In the early 80's machines were used in Yorkshire for making wide mouth bottles but attempts to make narrow neck bottles on these machines were unsuccessful. Up to the time of the Pierpont (later known as the Johnny Bull), all large narrow neck bottles in England, the United States, Germany, and France were made by hand. From 1898 to 1902, Grote in England, Boucher in France, Severin in Germany, and Christianson in Sweden tried to make narrow neck bottles on wide mouth machines. The Ashley Machine is said to have met with some success in England for this purpose.

According to the data contained in the Evans letter Grote actually made bottles on his machine but the machine was too slow in operation to make it commercially successful. In the United States the Grote machine was tried out in the Whitall-Tatum plant in Millville, New Jersey (now a division of Armstrong Cork Company). However, because of the aforementioned lack of speed the equipment, as far as this plant was concerned, was abandoned. Subsequently, a company was formed to promote the Grote Machine in England but this concern soon went into bankruptcy, no doubt due to the same inherent weakness. By 1908, nowhere were Grote machines to be found in use.

Another bottle making machine, contemporary with the Grote, was the Simpson. It seems, however, that this equipment was used only in the Simpson Glass plant and its efficiency was somewhat questionable.

In summing up all efforts to successfully produce large narrow neck bottles on a commercial basis by mechanized processes information indicates that no one had been able to accomplish the purpose up to the time of the Pierpont patents.

These Pierpont patents were issued in Great Britain about 1902 and it may be of some interest to note that



The United Automatic Machine as it was finally developed by 1919.

Mr. Evans, whose correspondence serves as a basis for this brief review, was acting for the P. B. M. Syndicate in their negotiations for the sale of their American patent rights.

The machine invented by Frank H. Pierpont, coloquially known as the Johnny Bull, is shown in his U. S. Patent No. 795,304, substantially as it was used both in England and in the United States. This machine was of duplex construction, identical apparatus being provided on each side of a central column. There was no power of any kind provided except compressed air for blowing. Each side of the machine was provided with nine handles, which were manually operated, and an air valve, also operated by hand. The Johnny Bull was a three-man machine, these men probably being two operators who manipulated the machine and one gatherer who delivered glass to both sides of the machine.

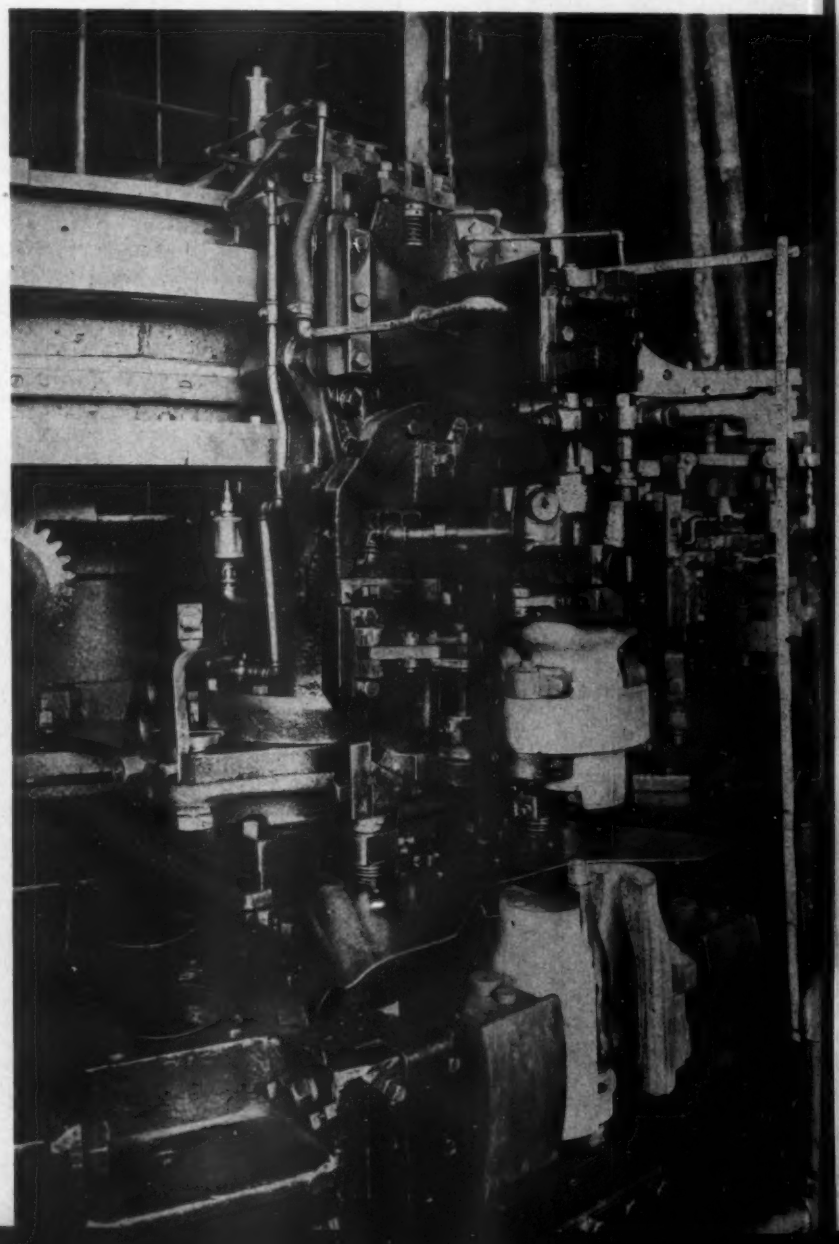
On the 26th of March, 1908, the United Bottle Machinery Company was organized for the purpose of marketing this machine in the United States, and from the name of the company, the Johnny Bull then acquired the name "United." This company secured two United States patents to Pierpont and one to Demming from the P. B. M. Syndicate. At first, they imported a number of machines from England, but these proved unsatisfactory and several had to be replaced. As a result of the difficulties with the British made machines, by January, 1909, fifty "Uniteds" had been built in the United States, which were cheaper and of better construction than the imported ones. These machines were made by the Fuches & Lang Mfg. Co., in Rutherford, New Jersey. One of the early machines without moulds is shown in Figure 1.

Numerous difficulties were encountered in introducing the new machines. The glass manufacturers were slow to adopt the machine, which differed radically from anything they had used previously, and another hindrance appeared when the Glass Bottle Blowers Association proved reluctant to furnish Union help to run the equipment. However, before the end of January, 1909, the Bottle Blowers agreed to a wage scale which was said to produce bottles at about one-half of the previous cost, and the beginning of 1909 saw fourteen machines of the United Company installed and operating. These machines were licensed for a period of seven years on a yearly rental of $500 each. During the year 1909, twenty-four additional machines were installed, making a total of thirty-eight.

Two hundred and ten dozen pint beer bottles were considered to be a day's work at the time of introduction of the new equipment, but as the workmen gained experience on the machines, as many as two hundred and forty-five dozen pint beers were made in a day. The United company made a substantial profit during the year 1909.

By the end of 1910, a total of seventy-one machines had been installed, and, as a general rule, the machines were proving highly satisfactory. The installation and use of the Johnny Bull or United continued to grow, and by the end of 1911, there were ninety-three machines in operation in fourteen different factories.

In spite of this adoption by American manufacturers of the Johnny Bull Machine during the year 1911, it became apparent that this hand-operated equipment would not be able to compete with the Owens' Machine, which was the only fully automatic machine on the market. Accordingly, the company undertook to design what was known as the "United Automatic Machine," which was expected to make a complete line of narrow neck and wide mouth bottles and jars. They assumed that it was



A mould-section close-up of the United Automatic.

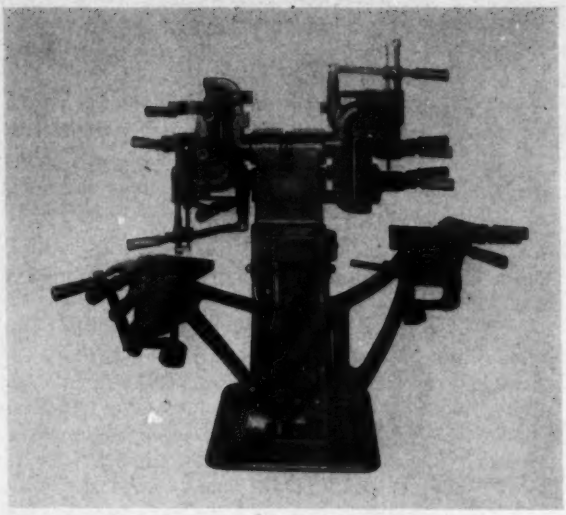


Fig. 1. The original three-man Johnny Bull Machine.

going to be very simple to mount a series of mechanisms similar to the Johnny Bull, on a rotary turret, to provide automtic actuating means, and to feed the glass to the blank moulds. It was hoped to have this automatic machine in operation within the next year, but numerous delays postponed the trial of this machine for several years despite the fact that glass manufacturers were deeply interested in the idea and very anxious for this new automatic machine.

During 1912 only one additional hand-operated machine was installed. This decline in further expansion, it appears, was due to the reluctance of the glass people to sign contracts agreeing to pay rental on machines for seven years, particularly in view of rumors that somewhere between six and ten new machines were about to be introduced, none of which, however, had been reduced to commercial form at this time.

Another pitfall in the chain of unfortunate circumstances was encountered by the action of the Glass Bottle Blowers Association in reducing the scale of wages for making hand blown bottles by about 20 per cent, which thereby reduced the savings over hand work that could be effected through the use of United Machines.

The year 1913 saw another spurt of the hand-operated United machines, however, and nineteen additional machines were installed, making a total of one hundred thirteen in use. Meanwhile, plans were being made to demonstrate the new automatic machine to the glass manufacturers and work was continued on the development of this equipment. The demand for machine made bottles was continuously increasing, however, the first United Automatic machine to be started was never completed and none of the new automatics were produced. Probably this machine was somewhat like that shown in U. S. Patent No. 1,849,555 to Sears. It was hoped that the second improved one would be ready for demonstration by about March 1, 1941.

Manufacture of the hand-operated Johnny Bull continued into 1914 but only one additional machine was installed during that year, making a total of one hundred fourteen, the largest number ever put into use in the United States. See Figure 2. During the same year two competing bottle machines were placed on the market and an outstanding characteristic of the new machines was that they both required less manpower for operation. One machine required but two men, the other needed only one man while the Johnny Bull was a three-man machine.

In December of 1914, the United Automatic Machine was said to be making bottles of a quality and at a rate which compared favorably with the Owens' machine. However, in view of later events, this seems questionable. One of the principal difficulties which was encountered was the development of an "automatic glass flow," or feeder, an essential for the successful operation of the automatic machine.

In the history of the rise and fall of the Johnny Bull as bottle making equipment, not only did 1915 mark the first year in which expansion ceased but it was the beginning of the end of this machine for the manufacture of bottles. By the end of 1915 the number of machines in use had dropped from the peak of one hundred fourteen to ninety-four.

By this time, however, limited progress had been made with the United Automatic Machine to the extent that one was running in Swedesboro, New Jersey, and a factory was hired from the Millville Bottle Works in Millville. The machine, however, had not reached the stage where it could be demonstrated.

By the end of 1915, a total of $109,795.40 had been

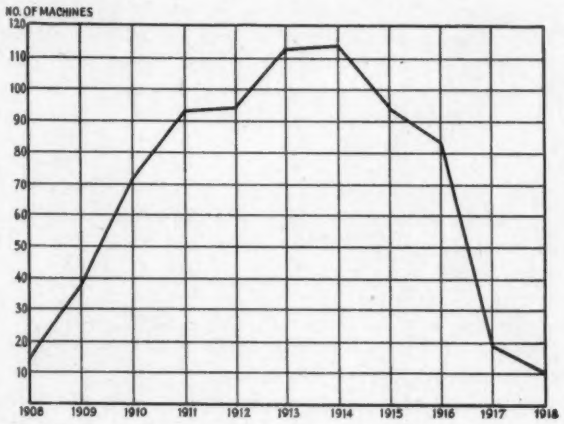


Fig. 2.

spent in developing the automatic machine, which was still not ready to be placed on the market and the company continued to look forward hopefully to the time when the new machine would begin to produce an income.

The competition between the United Machine or Johnny Bull and the new one-man and two-man machines continued through 1916, with the result that the number of United Machines in use dropped further to eighty-three.

Work was continuing on the Automatic Machine, but up to the end of 1916, they had found no successful solution of the basic problem — a method of automatically feeding glass to the machine. At this point plans were under way to borrow money to commercialize the Automatic Machine.

The displacement of the Johnny Bull by the competing machines became greatly accelerated so that by the end of 1917 there were only nineteen machines in operation.

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REDUCING ABSENTEEISM AND TURNOVER

Glass manufacturers are urged to keep labor turnover to a minimum to avoid possible penalties in the event of nation-wide Labor Rationing.

There was a time when employers—both in the glass industry and other fields—solved their absenteeism problem by simply making a rule. If Henry Smith failed to check in so many times in such-and-such a period, he simply found himself another job—if he could. But times have changed. While absenteeism may not be as common in the glass industry as in strictly war plants the problem confronting glass makers today, according to the Labor Relations Institute, is not that of preserving attendance through disciplinary methods, but rather one of exploring and removing the *causes* of absenteeism. The turnover situation is part and parcel of the same problem, for whatever causes workers to take unwarranted "days off" in time will cause them to seek other employment.

This dual threat to maximum production is further heightened by the imminence of Labor Rationing, the manpower priority system now in use in Buffalo and West Coast points and which Institute advisers expect will soon become nation-wide. Under the priority program, practically all hiring is done through the United States Employment Service, and private methods of recruiting employees virtually come to an end. Priority ratings are determined for each plant by a Labor Requirements Committee made up of representatives of the War Manpower Commission, the War Production Board and procurement officials of the Army and Navy. The priority rating given each plant is determined by three factors: (1) the importance of the product to the total war effort; (2) the extent to which available manpower is being used, and (3) what steps have been taken to minimize turnover and absenteeism.

So far as point No. 1 is concerned, there is little that the average glass manufacturer can do to improve his priority rating. The second point, better manpower utilization, can be facilitated through a census of skills, to be sure that every employee is working at his highest skill. But the third point does lie within the power of every employer to improve—and if the plant being rated has a turnover of more than 5 percent, the management may be called upon by the Labor Requirements Committee to demonstrate what it is doing to solve the problem.

There is no single remedy for absenteeism and turnover. In fact, they are *symptoms*, rather than diseases. The only practical specific technique is a willingness to ferret out the true reasons for absences, thus getting at the underlying conditions. That is why every company should know how much of its absenteeism is due to such factors as illness of the worker, illness in the family, "industrial fatigue," plant accident, accident outside the plant, housing conditions, transportation breakdowns, etc. It is also essential to distinguish between absences with permission—including vacations, suspensions and company business—and those which have been taken without excuse.

Better records are an important first step toward better attendance. *Trends* count more than individual absences, and reports on individual absences are important because they enable management to spot the trends as they develop. Different types of absenteeism run in waves, one rather obvious example being the absences due to illness during an epidemic of "flu." When the fever chart soars upward it may indicate the existence of a harmful rumor sweeping through the plant, or a drive by other plants to lure away the workers. More serious still, it may reveal a flare-up of resentment against supervisory abuses.

Determining the Causes of Absenteeism

The simplest way to get the information on which to base the trends is to require every employee who has been absent without excuse to report to the plant superintendent or other executive when he returns to work. This can be done in routine fashion by taking up the absent worker's time-card and replacing it with an "A.W.O.L." notice telling him where to get his card when he comes back to work. When he applies for it, he is interviewed by the executive (or—still more of an ordeal for the worker—by a committee of his fellow employees) and the facts are noted on a card for future reference. The more detailed the report, the more helpful it will be: illness, for instance, may have been caused by some condition within the factory, and the report may lead to correction of the trouble. A wave of accident and illness absences may reveal flaws in the safety and sanitation program.

No amount of flag-waving and patriotic appeals can equal the morale-building influence of corrective measures removing causes of complaints on the part of the workers. Excessive noise, insufficient lighting, poor ventilation, general disorder, add up to dangerous discontent. Improper nutrition leads to illness and lassitude, and that is why a plant cafeteria serving hot food and beverages does so much to improve morale and reduce absenteeism. According to the Institute, too much stress cannot be laid on safety and sanitation, and workers should be urged in every possible way to eat properly and regularly, bathe frequently and get plenty of sleep.

Excessive drinking, especially on pay-day, causes a certain amount of absence. In many localities where this condition formerly prevailed, the companies affected have reduced the evil by bringing pressure to bear on the local taverns. Many of them violate ordinances and state regulations by serving drinks to intoxicated persons, or by maintaining gambling machines. A solemn notice to the effect that such violations will be reported unless ex-

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COMPRESSED AIR LEAKAGE AND WASTE

Modern glass factories are a maze of pipe lines. Pipe lines for water, for gas, for steam, and for air. One characteristic that is shared by all types of pipe lines, regardless of what they carry, is their tendency to develop leaks. In piping systems that carry water such leaks make their presence known visually through drippage and its resulting puddles, steam line leaks likewise give visible evidence of their presence, while leaks in gas piping systems usually are revealed by their odor.

As such leaks not only represent a direct "dollar and cents" loss but also cause much secondary "dollar and cents" damage (which in many cases is the only reason they are repaired), the average glass plant maintenance crew generally does something about them. In the case of air leakage, however, the material in question is odorless, invisible, and does no serious secondary damage. Air leaks are therefore usually ignored by the maintenance crew. (It is true that even a small stream of escaping air makes quite a little noise but the usual glass factory does a very good masking job.)

However, especially during these times, it should be borne in mind that air leakage is wastage and that the financial loss from leaks in compressed air lines can assume considerable proportions. For example, the leakage of air at 100 pounds pressure through a single 3/8 inch orifice would amount to 6,671,900 cubic feet per month and at a cost of six cents per 1,000 cubic feet, this loss would amount to $400.30 per month. Figure 1 shows graphically the air losses for holes of varing sizes, based on air at 100 pounds pressure, a nozzle coefficient of 0.65 and air at a cost of six cents per 1,000 cubic feet. While actual leaks, of course, are not always round, it is the area that counts, and compressed air will escape regardless of the shape and size of the opening. When one considers the vast multitude of valves, hose connections, spuds, nipples, clamps, blow-guns and the like (all of which are potential causes of leakage), that are to be found in or on the air lines of the average glass plant it is evident that more than just passing attention should be paid to the detection and elimination of air leakage.

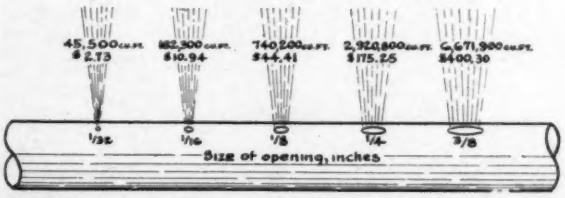

Fig. 1. Graphical illustration of compressed air wastage per month through leaks of various sizes.

There are various ways of testing for leakage. For example, a candle flame may be held (Figure 2) close to the joint to see whether or not the flame will flutter, or soapy water may be swabbed around the joints, and, if there is a leak, it will produce a soap bubble. The tightness of the entire system, that is, the air lines, air hose, shut-off valves, and other connections may be tested when the plant is not in operation, by packing the lines and shutting down the compressor and noting how rapidly the pressure drops.

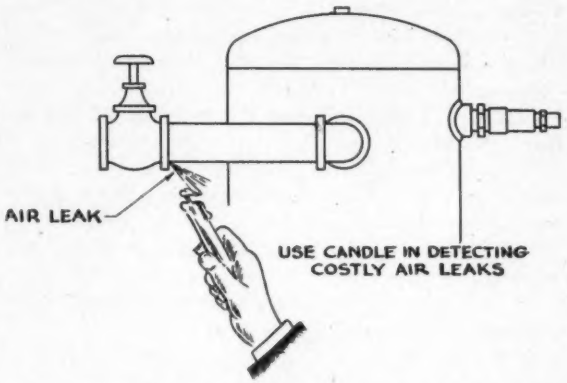

Fig. 2. Detection of air leaks by the candle method.

In practice, air leakage occurs at a great many locations but a few are quite common to most all air line installations. For example, the usual compressed air system has a great many valves, mostly small in size (usually one inch or less), which are located at or near the points where the air is used. Even a small leak through the packing of the valve stems of only a few of such valves will result in the excessive waste of air. Such waste can very easily be eliminated by simply repacking the valve stems.

Valves are also placed in the line so that branch lines can be shut off when not in use. In many cases these valves are left open when the branch line is not in use and if the connections and equipment on the open branch line are slightly leaky much unnecessary waste of air can occur.

At the hose ends, where the hose is attached to spuds or nipples, there can also be a surprising amount of leakage through lack of care or by neglecting to use the proper type of clamps. Many times hose can be found that has never seen a clamp. Not only does such a condition waste air but it also creates a safety hazard. Anyone who has seen the free end of a hose whip around when the air is turned on can realize the latent danger in hose joints that are not clamped tightly. Makeshift clamps such as those made by tying bailing wire around the hose are as bad a condition as the lack of a clamp. The heat and oily condition encountered in the glass factory quickly softens the best of hose and wire clamping will readily cut holes in any hose that is in such a condition.

Home made blow-guns such as those made from a globe valve plus a small piece of pipe as a nozzle are also a source of much leakage. With a makeshift gun such as the above the user may shut the valve but when

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THE MECHANISM OF GLASS CUTTING

PART II

From a practical point of view the following questions should be answered.

a. Has wetting of the surface to be cut any particular effect?

b. What is the relation between the behaviour of uncut glasses of varying thickness to those which have been cut?

c. Which factors influence the certainty of fracture along the cut?

In many shops it is a rule that the glass has to be moistened with kerosine. Questionnaires sent to various glass cutters showed that there is little understanding as to the reason for this measure. The following two explanations were offered by most glass cutters:

1. The use of kerosine reduces the force necessary for separating the glass along the cutting line.

2. The use of kerosine warrants greater certainty of the fracture occurring along the cutting groove.

These statements were examined experimentally. It was found that for hand cut glass plates the force necessary for breaking along the cutting groove seems to be reduced. No difference, however, could be found for machine cut glasses. In no case could any influence on the certainty of fracture along the cutting groove be observed.

The Modulus of Rupture of Hand Cut Glass Plates

The experiments were made with machine drawn window glass which had been cut into squares with 180 mm. long sides. The thickness was measured at four points, one on each side, with an accuracy of 1/100 mm. The average value was used for computations. A diamond cut then was made across the middle of the squares by an experienced glass cutter. This cut was made on the same side on which the squares were cut out from the original window glass.

The squares, with the diamond cut turned down then were put onto two metal supports which were 160 mm. apart. Exactly above the diamond cut on the upper surface of the glass another blade shaped metal was imposed. This upper metal blade carried, fastened thereto, a container into which about 50% of the assumed rupture load was put in the form of weights. To assure even increase of the further load the rest of the load was imposed by pouring water into the container. After fracture the filled container, together with its support, was weighed to determine the fracture load. The load was imposed within about 40 to 50 seconds. Also the diamond cuts were made not sooner than about 80 seconds before the squares were put into the modulus of rupture tester.

The following variations were tested:

1. Squares of varying thickness by dry cutting.
2. Squares of varying thickness with kerosine.

The results of this series are summarized in Figure 8. In this series it was actually found that the modulus of

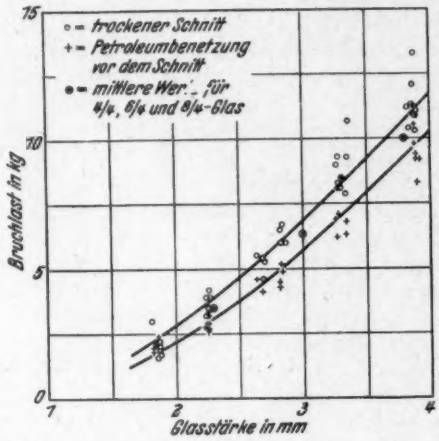


Fig 8. Non-aged hand cuts.

Legend: ○ = dry cut
+ = glass moistened with kerosine prior to cutting
⊙ = Average values
Bruchlast in kg . . . Breakage load in kg.
Glasstaerke in mm . . . Thickness in mm.

rupture was slightly lower in the case where the surface had been moistened prior to cutting. Results of this kind, however, are not readily reproduceable and the average breakage load in various experimental series varied considerably. For the purpose of more accurate observation the following experiments using a mechanical cutting test machine were made.

The Modulus of Rupture of Mechanically Cut Glass

The apparatus used is schematically shown in Figure 9.

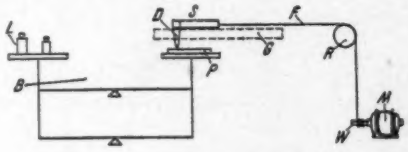


Fig. 9. Apparatus for mechanical cutting.

The glass plate P to be cut was put on balance B and the pressure with which it was to be cut was regulated by means of weights L. The diamond cutter D was attached to member S so that it could be tilted at any desired angle. Member S was movable on two rails G and was moved over the glass surface at even speed by means of motor M. The cutting speed was 1.7 cm. per second. This speed was chosen considerably slower than that used for hand cutting so as to avoid disturbances due to too sudden start of the moving mechanism. The cutting load used was 600 grams.

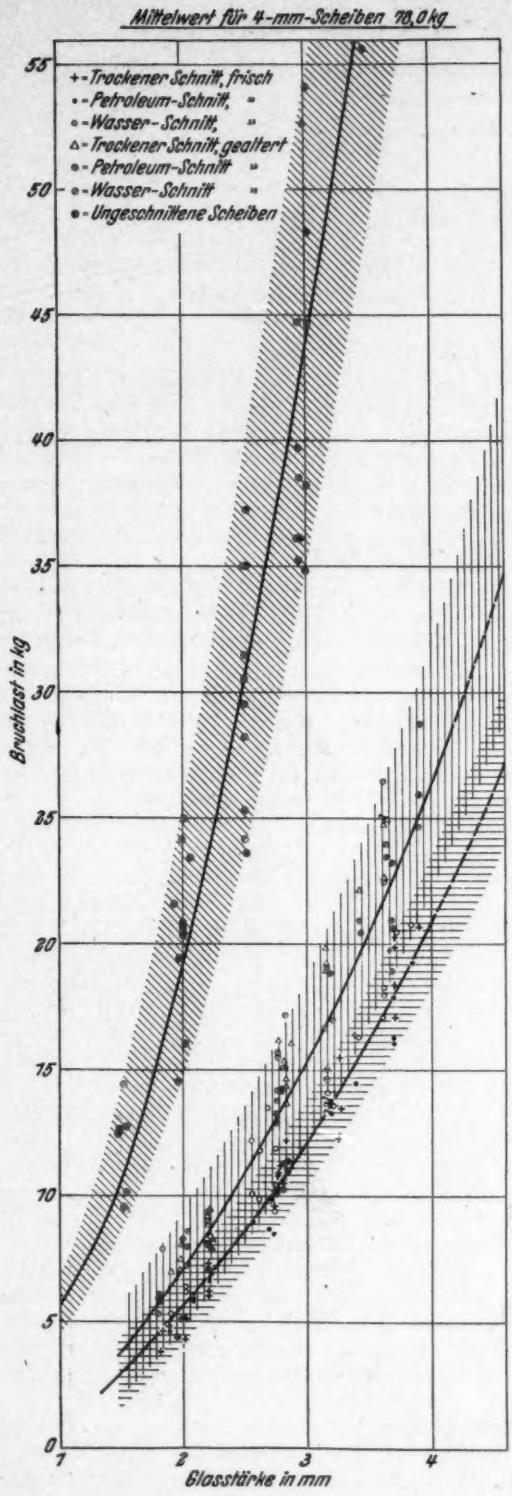


Fig. 10. Mechanical cuts on glass plates 18 x 18 cm.

Legend: + = dry cut, fresh ⊙ = gasoline cut, aged
● = gasoline cut, fresh ⊖ = water cut, aged
○ = water cut, fresh ⊕ = uncut glass
△ = dry cut, aged

Bruchlast in kg . . . breakage load in kg.
Glasstaerke in mm. . . thickness of glass in mm.

Such mechanically cut samples were investigated freshly cut or aged for 48 hours. Some samples were cut dry, while others had been moistened with gasoline or water prior to cutting. The results are summarized in Figure 10.

As can be seen there is no difference between moist and dry cuts. We also could not detect any difference between dry and moist cuts under the microscope, while other workers[4] are believed to have found differences in width.

The above results also are not in agreement with findings by Milligan[5] who investigated the modulus of rupture of scratched glass rods. He found that wetting of the scratches with paraffin oil lead to larger, and with water or alcohol to smaller, moduli than when scratching the dry rods.

We have found that the results obtained in experiments of this kind are dependant on a number of factors, such as age of the glass, change in surface properties and the type of cut or scratch used is of great influence. Comparison with results by other workers, therefore, has to be done with caution. Also there may be a principal difference between the behaviour of a "scratch" and a "cut".

That a difference in the modulus of rupture could be found for hand cut glasses may be due to the fact that because of decreased friction of a moistened glass the operator automatically may use a greater hand pressure on cutting, since he will judge, at least partially, the pressure used by the resistance offered to the cutting tool. Accordingly, the difference found for dry and wet cut glasses may be due to the well known effect of differences in cutting pressure applied. Unfortunately, it was not possible to test the pressure used at hand cutting, without simultaneously disturbing the operator, e. g. by the depression of a scale or spring the movement of the hand of the operator would be sufficiently disturbed to make objective measurement impossible.

Figure 10 illustrates that there is a substantial difference between the modulus of rupture of freshly cut and aged glasses. On the average, aged cut glasses are about 30% stronger than freshly cut ones. Comparing cut glasses with the uncut glasses it can be seen that the freshly cut glasses have about one fourth, and aged cut glasses about one half of the strength of the uncut glass.

It should be noticed that the scattering of modulus of rupture values for freshly cut samples is smaller than that of uncut or aged cut samples. This will be illustrated in the following table:

Glass Thickness	Scattering of values in % of average		
mm.	uncut	aged	freshly cut
2.0	28.2	32.6	26.3
2.5	25.3	25.9	17.2
3.0	22.6	21.5	13.9
3.5	19.9	19.6	12.6
4.0	19.6	19.4	11.7

Certainty of Fracture along Cut

It is believed that there is a close connection between the scattering of the modulus of rupture values and the certainty with which a glass will break along the cutting line. As has been mentioned before fracture may deviate from the cutting line. In this case the fracture will not

(*Continued on page* 80)

Research Digest

Practical Interpretations of Glass Technology

Experimental Studies of the Temperature Gradients in Glasses of Various Colors

From practical observations it is well known that the penetration of heat from the top surface of the glass down to the deeper sections, especially in tank melting, is influenced by the color of the glass. With certain colors the temperature gradient is very steep, and shallow tanks must be used if the tank operation is to be successful. The existence of this temperature gradient also is responsible for difficulties such as devitrification, stones, freezing of the throat, and low delivered glass tonnage.

In order to obtain more information on the magnitude of this temperature gradient and the effect of the color of the glass on the temperature gradient, Holscher, Rough, and Plummer (Journal American Ceramic Society, December, 1943) have recently reported the results of some interesting laboratory studies dealing with this problem.

In brief, their experimental procedure consisted of melting decolorized, undecolorized and various colored glasses in a small gas fired furnace of about 400 lbs. capacity and determining the temperature of the glass at various depths while the surface of the glass was held at a temperature of 2615° F.

Temperature gradients in commercial tanks melting both flint and colored glass were also taken by the means of an 11 ft. long water-cooled thermocouple assembly which was inserted down through the crown of the tank.

From the results obtained by these two different studies it was concluded by the investigators that: 1—In the case of iron glasses the temperature gradient is about three times greater when the iron is in the reduced state instead of the ferric state. 2 — Chromium oxide glasses (up to 0.25% Cr_2O_3) have about the same gradient as equivalent percentages of ferrous oxide. 3 — Manganese does not increase the gradient as much as other oxides giving similar visible color intensities. 4 — A small amount of cobalt yields a sky-blue color but decreases the temperature gradient (when compared with the temperature gradient of flint glass). Similar results were found with a selenium pink. 5 — Decolorization of flint glass increases the gradient in the first inch of the glass surface with little effect at lower depth. 6 — Colors can be near matches although the glasses have radically different gradients; the visible color or color intensity likewise is no criterion of the gradient expected. 7 — A crude relationship exists between the gradient and the amount of gas consumed to maintain a 2615° F surface temperature; the higher the gradient, the lower the amount of gas required; under similar gas consumption the higher the gradient the higher the surface temperature. 8 — There is a direct relation between the laboratory gradients and those in the commercial furnaces.

These conclusions and results are extremely interesting and go a long way toward clearing up some of the mysteries connected with the tank melting of glass. The authors also state that the subject is still under study and it is hoped that the relationship, if any, between the gradients and other melting problems, such as the amount of gas required, surface temperature, loads possible, devitrification and stone losses, can be determined.

Study of Diffusion in Glass

Very little is known about the subject of diffusion in glass although some of its effects have been observed, such as the diffusion of iron oxide from the hot end to the cold end of silica brick set in the crown of a furnace, the diffusion of the components of slag and other vitreous fusions in contact with refractories at high temperatures and the diffusion of color oxides and compounds in bodies, stains and glazes.

In an effort to learn more about the subject Pask and Parmlee (Journal American Ceramic Society, August, 1943) have made an introductory study of diffusion into glass from salts, using silver nitrate as the chief source of diffusing particles. The optimum test conditions were a temperature of 900° C and a test time of 108 hours. The results noted were: 1 — effect of time, 2 — the effect of temperature on the distance of diffusion, 3 — variation of silver concentration in the glass with the distance of diffusion, and 4 — a check of Ficks' law of diffusion.

It was found that the rate of diffusion for silver nitrate at a given temperature is practically constant up to about 10 hours of test time and then decreases. The increase of diffusion for a given time with temperature rise is more rapid. A break is shown at the softening temperature, and another probably is present at the temperature of rapid decrease of viscosity. Concentrations of silver from silver nitrate with distance of diffusion show a sharp change at the softening temperature of the glass. Ficks' law (as generally given) holds only for a limited time at the beginning of the experiment; the so-called diffusion constant is therefore not constant throughout the entire test period.

As this study is in the nature of an introductory investigation the results obtained lay the ground work for future studies along the same lines. With the accumulation of additional data and results it is quite possible that new methods of decoration (for example) in which coloration (or discoloration) sets in with the migration of a material into the glass surface may be developed.

Optical Glass

The December, 1943, issue of *Esso Oilways* carries, under the title "The Eyes Have It", a very interesting article on the use of optical glass in the present day instruments of war. The use of chemically treated glass surfaces is discussed along with other subjects such as prism making, lens making and mirror making. A general description is given of the various operations required before the "chunk of glass" becomes an "all-seeing eye." The story makes interesting reading for those of us who work with the common types of glass.

INVENTIONS AND INVENTORS

A Summary of United States Patents of Interest to the Glass Industry Issued During December

Compositions

The production of white opaque vitreous enamels using gas opacifiers is dealt with in patent 2,338,439 issued to Walter Kerstan of Frankfort-on-the-Main, Germany. Gas opacification depends upon the use of substances which on firing generate gas which produces a white opacity by the formation of small bubbles. The Kerstan process uses vinyl compounds and their polymers as the gas evolving substances. It is said to be especially suited to enamels containing little or no boron.

Furnaces

The melting furnace shown in Fig. 1 is described in patent 2,337,605 granted to Wm. Hogenson (Chicago Vitreous Enamel Products Co.) as a means for making vitreous enamel and various kinds of glasses. The batch is fed through roof openings onto hearths 11 and 12, and here it is melted by the heat from fuel burners. As fusion proceeds the glass trickles downward through holes in the hearth and accumulates in mixing chambers M. These chambers have sloping floors which carry the glass through a baffle wall 40 into a puddling chamber P from which it is tapped after it has become homogeneous. Heat would be applied in the various treating chambers.

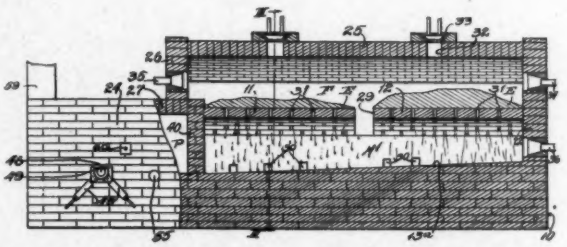


Fig. 1. 2,337,605: Hogenson. Melting furnace which allows vitreous enamel or glass to trickle through an upper hearth into a refining chamber.

Feeding, Forming and Shaping

Harold A. Wadman of West Hartford, Conn. (Hartford-Empire Co.) received patents 2,336,821 and 2,336,822 for methods of forming bottles in which portions of the parisons are cooled to increase the thickness of the product at desired points. For example, the first of these patents applies to lightweight containers which might tend to be excessively weak at the shoulders and bottom corner portions. In carrying out the invention Wadman causes a relatively intensified local chilling of the portions of the walls of the partially expanded body or parison which subsequently will become the shoulder and bottom corner portions of the container when it is blown to final size. This local cooling, which may be applied by air jets, prevents excessive thinning of the container at these points. The second patent is confined to non-circular containers such as panel bottles which have so-called longitudinal corners at which extra thickness is needed to give increased strength. This also is accomplished by controlled cooling of predetermined portions of the parison.

To eliminate internal moistness in glass blocks H. M. Louden and C. W. McCreery of Muncie, Ind., (2,336,874, Owens-Illinois Glass Co.) have devised method and apparatus which injects dehydrated air into both halves of the block, after they have been brought into juxtaposition just immediately before they close together to be permanently sealed.

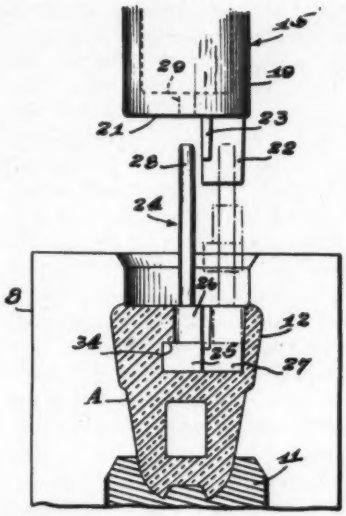


Fig. 2. 2,336,864: Holmes. Pressing glass insulators with an undercut cavity.

Another Owens-Illinois patent is 2,336,864, granted to M. K. Holmes of Muncie for apparatus as illustrated in Fig. 2, for pressing glass insulators with an undercut cavity. This allows the attachment of fastening devices of most any nature. The ware is formed in a two part mold. After a charge has been dropped into the mold, the pressing assembly is lowered. The glass rises until its upper edge is shaped by the bottom surface 21 of the assembly. The cavity is formed by a plunger unit, of which 22 is the main plunger, and 24 is the secondary plunger to which is attached an offset head 25 which forms the undercut cavity. In the view shown the glass has hardened enough to allow withdrawal of the main plunger which is attached to the pressing assembly. Afterwards, the secondary plunger is removed in a separate operation in which it is slid sideways and removed through the larger opening vacated by the main plunger.

Patent 2,336,162 issued to Ed. G. Bridges of Anderson, Ind., (Lynch Corp.) provides in forming machines of the rotary type a safety system that will disengage the driving mechanism and apply a brake to the mold carrier when a movable unit such as a mold has not been carried to its proper position.

Bernard Long of Paris obtained the issuance of patent 2,337,672 (vested in the Alien Property Custodian) for

a process of making cellular glass by mixing a glass mass with carbon and an oxide of arsenic for the evolution of the gases which develop the cellularity.

Miscellaneous Processes

Under certain conditions glassware, when being annealed in lehrs wherein the products of combustion directly contact the glass, becomes coated with a film of sodium sulphate due to the action of sulphur gases present in the combustion products. It has been suggested in patent 2,198,745 to coat the conveyor belt with sodium carbonate or other alkaline compound to absorb the sulphur gases, but E. W. Guernsey of Baltimore (Consolidated Gas, Electric Light and Power Co. of Baltimore) reports in patent 2,336,785 that the carbonate flakes off and does some damage when it settles on glass surfaces. To correct it he has devised a number of more adherent coatings which will not rub off so easily from the metal conveyor belt. He sprays the belt with solutions of sodium carbonate to which any one of several adhesives is added. He may, for example, use bentonite or sodium silicate. Above these, however, Guernsey prefers to mix the carbonate with sodium acetate which will carbonate in use, to form an especially adherent coating of sodium carbonate.

R. H. Dalton of Corning, N. Y., (Corning Glass Works) received patent 2,336,227 for a process which may be considered as an offshot of Corning's Hood-Nordberg Vycor process. The latter reported in their 1938 patent 2,106,744 that suitably chosen glasses could be formed into ware, heat treated to separate one glass phase from another, leached to remove the more alkaline of these components, and then refired to shrink the ware and thus to eliminate the minute pores left by the leaching. The product was a glass so high in silica that ordinary working methods could frequently not have produced such difficult ware. Dalton has now applied this process to the preparation of refractory quartz sealing glasses. He has other purposes such as the preparation of tubing which would otherwise be very difficult to prepare. In making a tube for a graded seal in which the glass composition varies from one end to the other he may leach the alkaline phase from only a portion of the preformed tube. This can be accomplished by standing the tubes on end only partially immersed in the leaching bath. The area rendered porous by the leaching may then be immersed in a bath containing boron or other glass-forming oxides, and when the article is afterwards fired the boron will fuse into the ware.

Patents assigned to Sylvania Electric Products Inc. include 2,336,678 to R. M. Gardner and R. L. Allen for lamp sealing apparatus, 2,337,740 to Chas. L. Albright for apparatus for coating the insides of long glass tubes with fluorescent materials, and 2,337,524 to G. A. Michael for a *method* of doing the same thing. A patent 2,336,946 granted to John W. Warden and Geo. Meister of Westinghouse Electric & Mfg. Co. describes a method of applying such coatings by introducing dry powder into the tubes and subjecting it to centrifugal force whereby it is caused to become distributed and affixed to the inner walls of the tubes in a wholly mechanical operation which uses no adhesive.

In patent 2,337,186 John J. Caugherty of Belle Vernon, Pa., uses a glass coating to protect special surfaces developed on steel articles while they are being heat treated. Such methods, which prevent oxidation and eliminate the need for acid treatment have previously been suggested, one prior idea being the choice of a glass with such annealing characteristics as to cause violent powdering or disintegration when cooled to about 400 F. Caugherty has found that if a uniformly thin coating of glass can be applied to the metal that it can be removed from the cool metal merely by flexing. In applying the process to coating wires, the latter are drawn through a bath of glass and then emerge through a die which scrapes off the excess glass to give a uniform and thin coating.

Harold Osterberg of Buffalo has assigned to Spencer Lens Co. his patent 2,337,679 for improved apparatus for

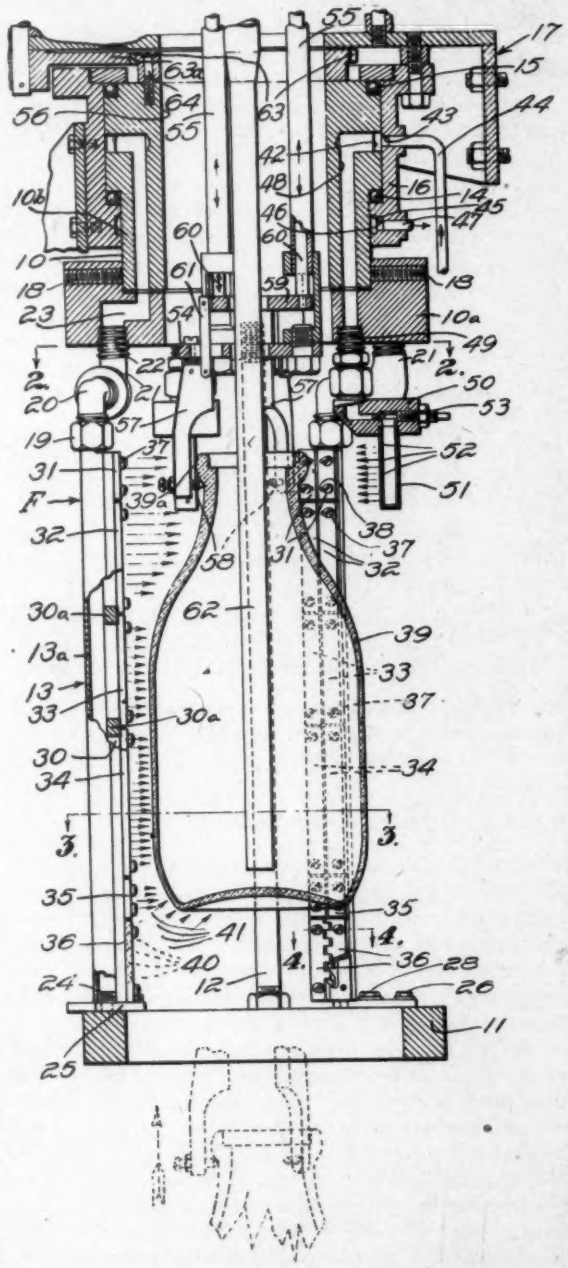


Fig. 3. 2,338,071: Mongan. Rotary blowing frame for tempering the outsides of bottles.

accomplishing the volatilization of magnesium fluoride or similar substances within a vacuum for the purpose of altering the reflection characteristics of lens surfaces on which the product condenses. Other patents on this process have been reviewed previously in this department. Innovations in this latest method are changes in the lectrode attachments and the use of a crucible made of graphite, silicon carbide or other carbonaceous material.

Fig. 3, from patent 2,338,071 granted to Chas. E. Mongan, Jr., (Hartford-Empire Co.) illustrates a method of tempering the outsides of bottles. While the ware is suspended by tongs from the neck, cooling air is blown through numerous jets onto the sides and bottom. The air conductor shown at the left is only one of several, and all are supported by a blowing frame which rotates around the bottle. The tube 62 provides simultaneous cooling of the inside surfaces.

Patent 2,337,877 granted to T. B. Drescher (Bausch & Lomb Optical Co.) covers a polariscope using monochromatic light from a discharge tube in serpentine or grid form, having considerable length, and being parallel to the ground glass plate.

John S. Harker of Vineland, N J., (Kimble Glass Co.) received patent 2,337,888 for a machine for scoring a plurality of cylindrical glass blanks having one closed end.

Sheet and Plate Glass

Arthur E. Spinasse of Mount Vernon, Ohio, has devised a new method of vertically drawing a sheet of glass so as to give by direct means a product which he reports as being comparable with conventional ground and polished plate glass. As shown in Fig. 4 from patent 2,336,510, he draws a heavy tapering meniscus of glass from the pool. On either side of point "c" the glass meets surfacing rolls which cool it appreciably and help to shape it into a thick blank. So that these rolls will slide on the glass surface they are driven in the opposite direction from that of the

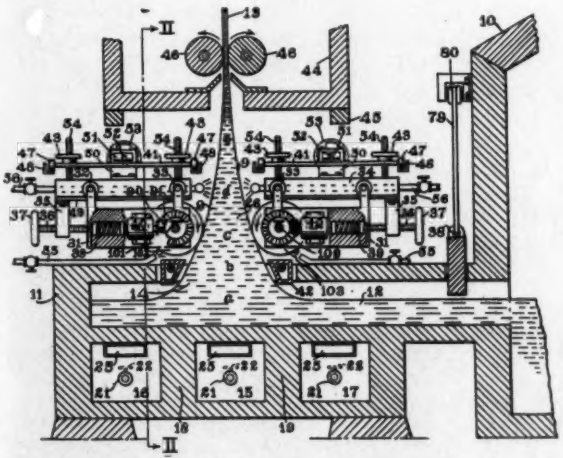


Fig. 4. 2,336,510: Spinasse. Vertically drawn plate smoothed by rolls moving counter to the direction of draw.

glass drawing. Their speed may be many times that of the drawing speed. After contact with the rolls the glass surfaces may be given a fire finish by means of burners at level "d".

The American Security Co. was assignee of patents 2,336,170 issued to Lewis Jex-Blake Forbes and James Heaton of England, and 2,336,200 to Lambert von Reis of Solberg, Germany, both being concerned with the tempering of glass sheets. The first describes apparatus for shutting off the chilling medium from portions of the apparatus and simultaneously interposing an obstruction so that sheets cannot be moved into those portions from which the chilling medium has been cut off. The von Reis patent prescribes a tempering method in which a plurality of lugs or stops touch the sheets at points spaced throughout their area so that the chilling blasts cannot blow the sheets awry to damage them. This patent has been pending for more than six years.

In describing his new process for making laminated safety glass, Joseph D. Ryan of Libbey-Owens Ford Glass Co. (2,337,275) first relates the difficulties encountered when a film of plastic is first flowed onto glass sheets, which are then dried to remove the solvent and finally bonded together under pressure. The drying requires considerable time and the escape of the solvent causes bubbles unless extreme care is used. In his new process no solvent is used. Instead there is only plastic plus the plasticizer. Ryan has found that when any one of the common plastics or resins such as cellulose acetate is homogeneously mixed with a plasticizer and then spread as a film to stand that excess plasticizer will exude and come to the surface as a thin liquid. A given plastic has a definite plasticizer retentivity for a given plasticizer. Based on these relationships Ryan has developed a process for making safety glass, using plastic and an excess of plasticizer above the ability of the plastic to retain it. Such a mixture is spread thin on both glass sheets which are to be joined. They then are allowed to stand until the excess plasticizer is exuded, and finally the two sheets are joined and sealed permanently in the usual pressure chamber.

Libbey-Owens-Ford and Eastman Kodak share equally the assigned rights under two other current patents. These are 2,336,531 and 2,336,532 granted to Jos. D. Ryan and F. R. Conklin. The first covers laminated glass in which the inner plastic layer is made from 100 parts cellulose acetate butyrate and 70 to 100 parts of a plasticizer consisting essentially of an alkyl phthalate. The second patent uses an inner layer of the same amount of this plastic plasticized by 40 to 100 parts of dibutyl sebacate.

In another Libbey-Owens-Ford patent, 2,336,544, John J. Hopfield describes a method of fabricating multiple sash glazing units.

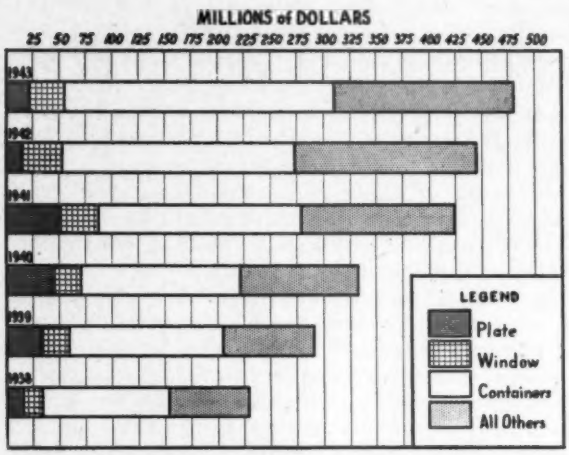
A compound glass sheet for blackboards is discussed in patent 2,337,757 assigned by Jos. H. Lewis to Blue Ridge Glass Corp. of Kingsport, Tenn. It is made without organic bond from three glass layers, the first being mat surfaced to provide the drawing surface, the inner layer being an opaque glass, and the backup layer containing wire reinforcing. The heat diffusing rate of the opaque glasses which could be used for the inner layer are so low that Lewis believes such a product has not previously been made which could be annealed in the usual manner in tunnel lehrs. He uses so thin a layer of this type of glass that the ordinary annealing process is applicable.

(*Continued on page* 90)

CURRENT STATISTICAL POSITION OF GLASS

THE GLASS INDUSTRY'S INDEX

Production: Eleven Months, January Through November



Activity in the glass industry during November, 1943, was at approximately the same level as for the previous month. According to the Production Index, output during November was $47,000,000 as compared with $40,000,000 for the same month of 1942. The cumulative total for the first eleven months of 1943 was $487,000,000 as compared to $445,000,000 for the same period of 1942.

Plate glass production for the month of December totalled 7,788,690 sq. ft., according to the report of the Plate Glass Manufacturers of America. This showed an increase of more than 5 per cent over November, and of 55 per cent over December, 1942. Total production for the year 1943 was 74,770,310 sq. ft. as against 62,248,897 sq. ft. for the year 1942 — an increase of 20 per cent.

Glass container production during December totalled 7,671,102 gross, according to the Glass Container Association of America. This showed a decrease of about 2 per cent from the preceding month, and an increase of 22 per cent over December, 1942. Total production for 1943 was 92,706,953 gross as compared with 78,640,999 gross for 1942 — an increase of slightly over 17 per cent.

Shipments of glass containers during December decreased a little over 2 per cent from November, but showed an increase of nearly 18 per cent over December of 1942. Total shipments for 1943 amounted to 94,540,000 gross, an increase of 19 per cent over shipments made in 1942.

The outstanding gains made over December, 1942, were: narrow neck food containers—21 per cent; wide mouth food containers—34 per cent; medicinal and toilet ware—34 per cent; general purpose ware—28 per cent; domestic fruit jars—250 per cent, and domestic jelly glasses—425 per cent. A decrease was shown on beer bottles—32 per cent and milk bottles—7 per cent. Major increases for 1943 over 1942 were: narrow neck food containers—31 per cent; wide mouth food containers—35 per cent; medicinal and toilet ware—23 per cent; general purpose ware—49 per cent, and domestic fruit jars—132 per cent.

Inventories on glass containers for December were 4,392,300 gross—48 per cent less than the same month a year previous.

Automatic tumbler production for December amounted to 4,400,410 dozens, a 15 per cent increase over the total for December, 1942. During 1943 total output was 55,524,133 dozens, or an increase of 8 per cent over 1942. Shipments of automatic tumblers during December were 4,500,048 dozens, as compared with 3,746,498

CURRENT GLASS CONTAINER PRODUCTION

(All Figures Are in Gross)

	Production		Shipments		Stocks	
	Dec. 1943	Dec. 1942	Dec. 1943	Dec. 1942	Dec. 1943	Dec. 1942
Narrow Neck	487,268	328,871	514,760	417,553	241,494	616,037
Wide Mouth	2,272,796	1,630,895	2,270,552	1,735,252	787,337	1,292,079
Pressed	83,359	47,520	102,307	45,649	30,669	55,913
Total, Food Containers	2,843,423	2,007,286	2,887,619	2,198,454	1,059,500	1,964,029
Pressure and Non-Pressure	388,499	363,438	407,025	362,109	255,907	333,591
Beer Bottles	583,225	752,227	586,216	822,941	127,276	311,840
Liquor Ware	850,744	850,062	873,692	868,396	437,991	1,482,235
Medicine and Toilet Preparations	1,962,871	1,452,635	1,996,294	1,491,120	1,747,262	2,496,669
General Purpose	673,309	522,772	670,069	515,964	308,272	589,042
Milks	249,415	263,685	250,884	288,381	337,168	351,538
Fruit and Jelly	119,616	86,628	54,675	16,367	118,924	244,955
Total Industry	7,671,102	6,298,733	7,726,474	6,563,732	4,392,300	7,773,899

dozens shipped during December of 1942. Total shipments for the year 1943 were 56,164,492 dozens, or approximately 1½ per cent over 1942. Finished stocks on hand at the end of the year amounted to 6,678,552 dozens.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and household glassware were reported at 2,021,171 dozens for December, a decrease of 46 per cent from 1942.

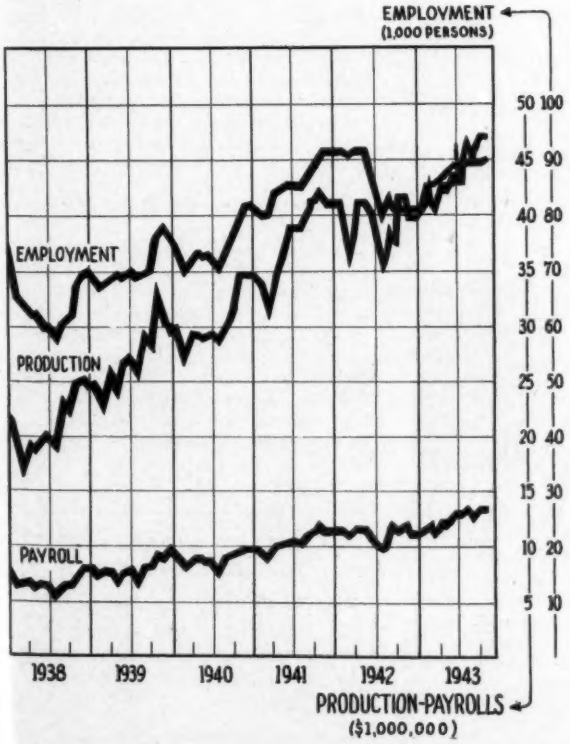
Miscellaneous glass products manufactured in November were estimated at $18,000,000, which was $1,000,000 higher than the figure reported in October. During the first eleven months of 1943 miscellaneous glass products totalled $181,000,000, comparing with $172,000,000 for the January-November period of 1942.

Employment and payrolls: The number of persons working in the glass industry during November totalled 91,000, a slight increase over the number shown for the previous month. This compares with 81,000 employed in November of 1942.

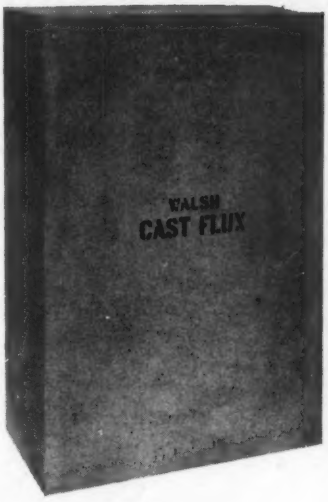
Payrolls in November were estimated at $13,500,000, which is the same as that shown for the month of October. This is a 17 per cent increase over November, 1942. Glass manufacturers paid out about $153,500,000 in salaries for the first eleven months of 1943.

GI THE GLASS INDUSTRY'S INDEX

Monthly Trends Through November, 1943



WALSH CAST-FLUX



The Vacuum-cast flux block of superior quality.

Walsh Cast-Flux blocks are machine-trued to exact size and shape after burning.

THEY LAST LONGER

The excellent results obtained in numerous tanks melting various types of glass has definitely established the efficiency and economy of Walsh Cast-Flux blocks.

Walsh Cast-Flux has a dense, uniform structure; it is burned at higher temperatures, is thoroughly bonded and possesses a low coefficient of expansion.

Walsh Cast-Flux blocks meet the most rigid requirements for tanks operating at higher temperatures . . . they insure greater tonnage, higher quality glass, freedom from defects, longer life and maximum economy.

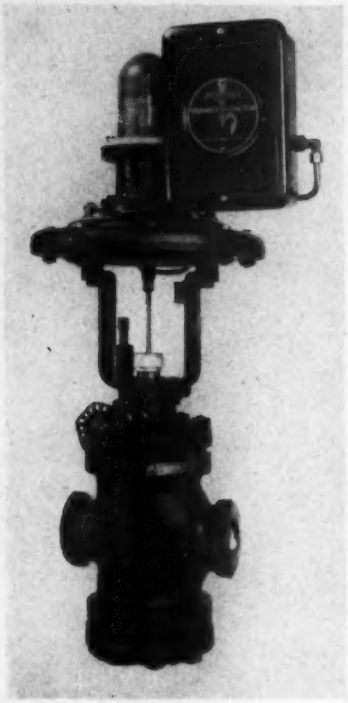
WALSH REFRACTORIES CORPORATION

Manufacturers of Refractories for the glass industry for over 50 years

4428 North First Street
St. Louis Missouri

NEW EQUIPMENT AND SUPPLIES

NEW FEATURES IN FOXBORO VALVACTOR



The Foxboro Company, Foxboro, Mass., announces that their new Foxboro Vernier Valvactor features new capabilities as well as new convenience and sturdiness. The Foxboro Vernier Valvactor is a micro-positioner for pneumatic motor valves. It is used to insure precise and dependable valve response, especially where operating conditions may make the response uncertain, slow, or unsatisfactory. It is actuated by air pressure changes as slight as the equivalent of ½ inch of water, and can compel valve stem movements as small as 1/1000 of an inch.

The new unit retains the outstanding advantage of relay action so successful in eight years of widespread use. Flexure type bearings, in place of pivots, eliminate the effects of mechanical vibration, without loss of sensitivity. Although the Vernier Valvactor retains the same general external appearance, new ruggedness has been provided for it by a heavier metal case.

NEW DUST COLLECTOR

The Pangborn Corporation of Hagerstown, Maryland, announces that they have recently placed on the market their new Industrial Type "CK" Unit Dust Collector. This unit is designed for smaller air volume dust control problems where a self-contained unit is needed.

The unit consists of two major sections—a preliminary centrifugal section and a secondary cloth screen section. Dust laden air enters the centrifugal section where the bulk of the entrained material is separated from the air stream. The air then flows upward to the secondary cloth screen section where the fine dust is effectively filtered from the air. The cleaned air then passes to the exhauster and is discharged.

This equipment is suitable for industrial dust problems produced by grinding, buffing and polishing operations; blast cleaning equipment; process plant machinery; and dry dust producing operations of all kind.

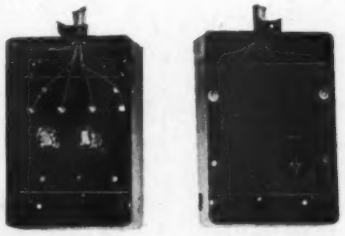
ELECTRO PLASTIC PROCESSES TAKES OVER NEW METAL PLATING

The new process of metal plating on plastics and glass, developed by Precision Paper Tube Company, has been taken over by the Electro Plastic Processes in Chicago.

Stronger unity of bond between metal and plastic is obtained by the new process. It withstands impact, vibration, and extreme temperatures without peeling or blistering, to the limits of the dielectric itself, which is greatly strengthened by the plating.

ELECTRONICALLY CONTROLLED BIN LEVEL INDICATOR

A dry materials bin level indicator that operates entirely on the electronic principle is now available through Mosher Electronic Control Systems. Since there are no moving parts to wear or get out of order the indicator is very practical. For this reason, also, clogging, arching, and mechanical breakdown is eliminated.



Use of this indicator gives a complete check on shipping and storage operations and thereby prevents possible loss of material through spillovers, underfills, or other miscalculation. The system is easy to install and inexpensive.

The device consists of two parts—the first a detector box and the second a signal control attached to a series of colored lights that show when the bin is full, empty, etc.

CATALOGUES RECEIVED

Copper & Brass Research Assn., New York, New York. This organization has recently published an 80-page "Pipe and Tube Bending Handbook." It is an excellent handbook of practical methods for bending pipe and tubes of copper, brass and related alloys. The volume is well illustrated with photographs and diagrams, and there are 34 pages of tables on standard pipe sizes, tolerances for standard pipe, tables to determine sizes, and tables on computing weights of copper, brass and related alloys.

General Electric Company, Schenectady, N. Y. Electronic heaters for heating metals are featured in a new, illustrated bulletin issued by General Electric. The publication describes the electronic method of heating metals, emphasizes its simplicity, and gives in detail the specifications of both the 5-kw and the 15-kw, 550 kilocycle electronic heaters.

The Askania Regulator Company, Chicago, Ill. This company has recently published a new bulletin titled, "Askania Pressure Control," describing completely the application of Askania regulator equipment to pressure and flow control problems. One of the features of the bulletin is the valve sizing chart — showing how butterfly valve sizes may be determined in a quick and easy manner.

The Meyercord Co., Chicago, Ill. This Decalcomania manufacturer is distributing an informative check-chart showing how to select and specify the right Decalcomania nameplate for 16 different types of surfaces. Published in file folder form to hold subsequent data sheets to be distributed periodically, it also contains a check-list of 25 wartime uses for Meyercord Decalcomania.

Keystone Carbon Company, Inc., Saint Marys, Pa., has just published a 32-page booklet entitled "Powder Metallurgy", covering the advantages and latest applications of powdered metal parts. Of particular interest to companies investigating the possibilities and advantages of parts produced by this method are the Designers Aid Section and table on Engineering Properties.

CATALOG & BULLETIN SERVICE

Current catalogs and manufacturers' service bulletins reviewed in this department may be obtained by writing to THE GLASS INDUSTRY.

	Furnace A	Furnace B	Furnace C	Furnace D	Furnace E	Average	Your Furnace ?
TOTAL LIFE	678	1069	920	884	984	907	
OPERATING DAYS	629	1006	839	833	964	854.2	
IDLE DAYS	49	63	81	51	20	52.8	
MELTING AREA	392	378	522	504	504	460	
TOTAL TONS PRODUCED	45825	74137	63940	65011	82582	66299	
SQ. FT./TON/DAY	5.38	5.13	6.84	6.46	5.88	5.94	
TON/SQ. FT./LIFE	116.9	196.1	122.49	128.9	163.73	145.6	

Five Campaigns Point To ONE Conclusion!

THE chart above gives the vital statistics for five recent complete campaigns on several tanks operated by one flint glass container manufacturer. All the furnaces were "complete balanced Corhart Electrocast units."

The average figures, at the right, are not only interesting —they indicate possibilities for every operator of glass tanks. The long average life of 907 days, at the very high average production rate of 5.94 square feet per ton, is especially significant.

Also, the factor "tons-per-square-foot, per life", offers a very handy means by which any manufacturer can compare his own furnaces' performances. This factor reasonably applies to all furnaces, regardless of size. The national average, some 15 years ago, was certainly not more than 40 tons. The average for the five furnaces above is 145.6— an average which represents the industry's very noteworthy progress in the technique of efficient glass-making.

Corhart does not claim that these advances are solely due to the refractories used. But, in our opinion, the conclusion is that sound engineering, good melting practice, *plus* the judicious selection of refractories which can withstand punishment, are the factors that make such performances possible.

Corhart Refractories Company, *Incorporated,* 16th and Lee Streets, Louisville 10, Kentucky.

QUALITY ECONOMY ENDURANCE

CORHART ELECTROCAST REFRACTORIES

THE JOHNNY BULL . . .

(*Continued from page* 65)

This rapid decline of what promised to be a most successful and lucrative enterprise greatly alarmed the United Management and it was realized that the only hope for any future profit lay in the successful completion of the Automatic Machine. The bugaboo of their time as far as this machine was concerned was the lack of an efficient "feeder" and the discouragement and frustration which was overtaking the management was revealed by George Alexander, President of the United company in his annual report dated January 2, 1918 in which he stated: "Automatically feeding glass for the making of narrow neck bottles is a most difficult method and surrounded with great obstacles not easily overcome."

By his time the total cost of the development of the Automatic Machine had risen to the important sum of $212,429 and while every possible effort had been made to perfect it, the result was never satisfactory.

A stockholders' meeting was called on April 2, 1918, at which time bottles made on the Automatic Machine were to be shown them. The Automatic Machine was considered by them to be the most practical and best bottle machine in existence, but further changes were deemed essential before commercial operation was possible, and funds were running low.

Finally, on May 4, 1918, the United Bottle Machinery Company was declared bankrupt. The Trustees in Bankruptcy continued in an effort to produce a commercial machine, but about 1920 such assets as remained were sold for what they would bring.

The photographs of automatic equipment show the final construction of the machinery. These pictures were probably taken early in 1919 in Millville, New Jersey. By that time there were several bottle machines and glass feeders in highly successful operation, and it was apparent that the United Automatic was hopelessly beaten.

While the Automatic never achieved the success which its promoters had hoped for, credit should be given to the original Johnny Bull as a trail blazer in bottle making machinery. In its day it was an outstanding success.

NEW VICE PRESIDENT ELECTED AT PITTSBURGH PLATE GLASS

At their January meeting the Board of Directors of the Pittsburgh Plate Glass Company elected R. B. Tucker a vice president of the Company. He was formerly director of glass sales. In his new position Mr. Tucker will continue to direct airplane assembly sales, plastic developments, and the export and optical departments.

Previous to his joining the staff of this company in 1929 Mr. Tucker was general manager of the Building Supplies Company of Norfolk, Virginia, and president of the Standard Plate Glass Company of Pittsburgh.

BACK THE ATTACK!
BUY WAR BONDS

GEORGE ESTES BARTON RETIRES

George Estes Barton has retired as Chief Chemist Emeritus of the Whitall-Tatum Division Plant of the Armstrong Cork company at Millville, N. J, after nearly half a century of service to the glass industry.

A testimonial dinner, sponsored by the Foremens' Association of the Armstrong Cork Co., at Millville, was tendered Mr. Barton on January 25 in recognition of his loyal service and his scientific activities and accomplishments.

Tribute was paid to him by Mr. E. C. Emanuel, Chief Chemist of the Glass and Closure Division; Mr. E. Claxton, Director of Research, Mr. J. C. Feagley, Vice President, and Mr. J. L. Bacon, Millville Plant Superintendent, all of the Armstrong Organization.

Among Mr. Barton's contributions to the glass making process have been the installation of thermocouples and temperature control equipment, the use of the polariscope for judging annealing strain and the use of small amounts of sulfate and barium in bottle glass to assist in the melting and fining. Records in the industry are not available to determine whether Mr. Barton was the actual pioneer in this country in the use of these techniques, now so commonly accepted, but it is known that he worked them out independently through the application of his thorough knowledge and keen powers of observation. It is believed that he was the first to use pyrometric equipment and the polariscope in the glass plant and was among the first to discover the benefits of barium and sulfate.

In the early years of the present century, Mr. Barton developed a formula for an adequate chemical glass which could be melted in pots. This glass, known as "Non-Sol", was manufactured by the Whitall-Tatum Company up until the time of World War I. Prior to Barton's development chemical glassware had been imported.

Shortly after his employment in 1896, Mr. Barton prepared a series of accurate volumetric standards for the calibration of glass graduates, at that time the recognized graduates being imported. Tables and other material worked out by him are employed in the manufacture and specification of volumetric glassware today and numerous articles on various phases of this subject have been contributed to the literature by him.

Mr. Barton's record of service to the American Ceramic and American chemical societies would require more space than is available for completeness. Among his activities, however, were the chairmanship of the Glass Division, Associate Editor of the Chemical Abstracts, Chairman of the Philadelphia Section and a long period of service as councillor of the Philadelphia Section.

When the Armstrong Cork Company acquired the plant from the Whitall-Tatum Company in 1938, Barton was Chief Chemist. He continued in that position until 1942 when, at the age of 71, he was retained in an advisory capacity to Dr. K. C. Lyon, present Chief Chemist of the plant.

GLASS IN THE WAR AND B_2O_3

In this war of materials, glass is playing a tremendously important part. Many kinds of glass are directly or indirectly aiding the over-all effort. From the lowly bottle or jar to the finest precision bomb-sight lens, glass is filling requirements that no other product can meet. Not all glass contains Borax or Boric Acid but in some glasses these products are absolutely essential, depending upon the specific use for which the glass is intended. Twenty-Mule-Team Borax and Boric Acid is directly contributing to the war effort where these materials are essential batch ingredients. Those manufacturers who are not now using Borax will find definite advantages in quality of product and manufacturing operations by inclusion of Borax in the batch formula.

PACIFIC COAST BORAX COMPANY

DEPARTMENT G • 51 MADISON AVENUE • NEW YORK

MECHANISM OF GLASS CUTTING . . .

(*Continued from page* 69)

"utilize" the energy provided by the cut. Thus, the modulus of rupture will appear to be larger by a not predeterminable amount (scattering) than in the case where fracture and cutting line coincide.

We may assume similar phenomena to take place as have been described by Smekal[6] with respect to the "scattering range of 'Materialkurve'" in the computation of absolute strength properties of glass.

It may be concluded that the manner of cutting has a strong influence on certainty of the fracture and on the modulus of rupture. Some preliminary experiments showed that when using a different diamond having the cutting edge at a more favorable angle and when using a higher cutting speed the modulus of rupture was changed for about 230 to 100%. Such tremendous deviations lead to the following *practical conclusions:*

It happens frequently that some glass coming from a continuous production line appears to be more "brittle" than usual. In other words some pieces of glass will not fracture as nicely along the cutting line as others. The uniformity of annealing and production in modern practice makes it difficult to detect noticeable changes in stress and strain distribution of the glass. At any rate in most cases it is not possible to attribute the "brittleness" to abnormal tensions in the glass. However, the findings described have shown that even small variations in storing time of the glass, and even more so in the cutting operation (type of diamond, cutting pressure, manipulation of tool, cutting speed) can cause very noticeable changes in type of cut and fracture obtained and thus may *simulate* such a "brittleness".

In order to investigate the possible influence of kerosine on the certainty of fracture along the cutting line a glass plate (thickness of three mm.) was cut by an experienced glass cutter into strips (5 x 500 mm.) with and without the use of kerosine. Out of fifty dry cuts six, and out of fifty moist cuts, nine strips showed faulty fracture. Accordingly, the difference, if any, is only very slight.

The certainty with which a fracture will follow the cutting line is also dependent on another factor. Figure 11 shows that the lateral cracks which are formed away from the cutting line do not proceed at right angles, but obliquely. Therefore, fracture must proceed more easily if it proceeds into the angle of the cracks (direction of dashed angle in Figure 11). It should be noticed that usually glass cutters fracture the cut glass from the side at which they finished the cut. In so doing they do not only start at the less aged part of the cut but also fracture the glass in the direction of the point of the angle formed by the lateral cracks, whereby danger of deviation of the fracture is reduced.

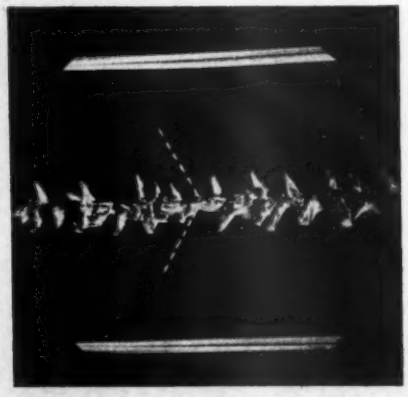


Fig. 11. Cut, viewed from above in the dark field. Magnified 25 times. The angles (dashed lines) of the lateral cracks are about 120 to 130°.

These lateral cracks also offer an explanation of why aged cut glass, although only slightly stronger than freshly cut glass, shows less certainty of fracture along the cutting line. While in the fresh cut the perpendicular crack will determine the fracture, ageing will decrease this effect as discussed earlier in this paper. In a "bad" cut, the lateral cracks will be of equal importance and thus decrease the certainty of fracture along the cutting line. Accordingly, in the time immediately following the cutting both the force necessary for fracture is decreased and the certainty of fracture along the cutting line increased.

[4] G. Tammann and H. Elsner v. Gronow. The Cutting of Plate Glass. Z. amorg. allg. Chem. *201*, 37-40, 1931.

[5] L. H. Milligan. J. Soc. Glass Techn., *13*, 351-360, 1929.

[6] A. Smekal. The Nature of Mechanical Strength Properties of Glass. Glastechn. Ber., *15*, 259-270, 1937.

CHANGES IN TEACHING STAFF OF THE NEW YORK STATE COLLEGE OF CERAMICS

The following changes in the college staff of the New York State College of Ceramics have been announced by Dean M. E. Holmes:

Assistant Professor J. F. McMahon is now Professor of Research in charge of the experimental work of the Ceramic Experiment Station.

Professor C. R. Amber is to be Director of the Ceramic Experiment Station.

Professor R. M. Campbell has been promoted to the position as Head of the Department of Ceramic Engineering in charge of all the work leading to the Bachelor of Science degree in that department.

Mr. Charles M. Harder is now Head of the Department of Industrial Ceramic Design.

Dr. Van Derck Frechette of the Corning Glass Works has been employed as Professor of Ceramic Technology in charge of Petrography, XRay Analysis and Enamel Ware courses.

LT. COL. YOUNG EXECUTIVE VICE PRESIDENT OF WICKWIRE SPENCER AVIATION

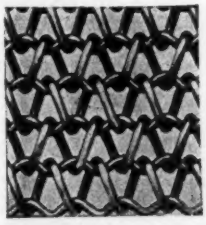
Wickwire Spencer Steel Company has announced the appointment of Lt. Col. Cecil P. Young, U.S.A. Ret., as Executive Vice President of the Wickwire Spencer Aviation Corporation, a subsidiary of Wickwire Spencer Steel.

Lt. Col. Young's experience in the aeronautical field dates from World War I when he was a member of the 96th Bombardment Squadron. Considered one of the country's outstanding combat flyers, he has devoted himself since 1918 to the study of plane development and pilot training.

Up Your Operating Efficiency

CAMBRIDGE

BALANCED TYPE BELTS



Note the alternate spiral construction and crimped wire connection in this Balanced Mesh Belt.

This new catalog is a practical source of reference for all belt-users. Write for your copy.

PERFECTLY adapted for annealing all types of hollow ware, Cambridge Balanced Lehr Belting assures highly efficient production—uniform quality products.

This special balanced construction—alternating spirals connected with crimped wires—eliminates side creep and provides an absolutely flat carrying surface. Despite the tremendous strength of these belts, they are so flexible that they pass over any diameter of pulley or driving drum. They are obtainable in specifications to suit your individual requirements.

Our engineers, located strategically throughout the country, are quickly available to you to assist you in planning efficient belt installations. Write for assistance or information.

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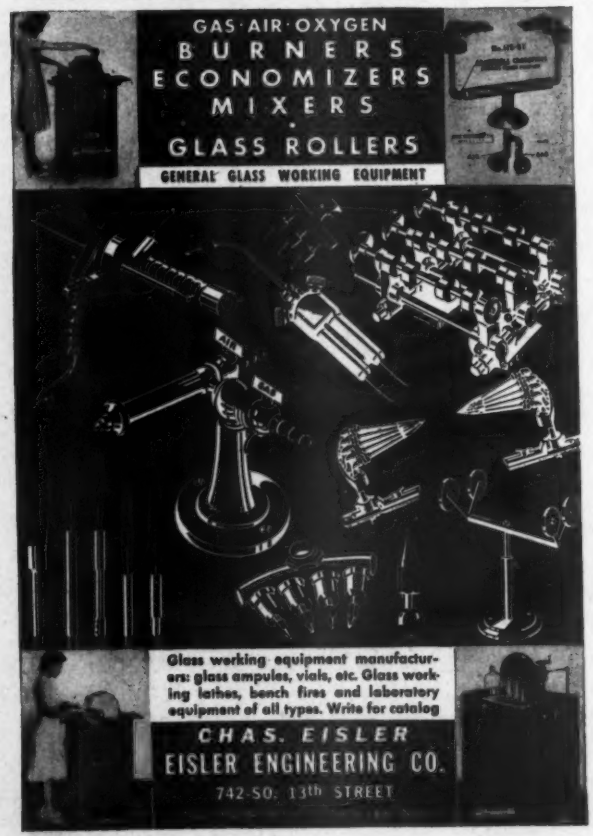
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EISLER ENGINEERING CO.
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COMPRESSED AIR LEAKAGE . . .
(*Continued from page 67*)

putting it down can easily and accidently crack the valve open. In addition there is the danger of an excessive blast of uncontrolled air blowing dirt and broken glass into the ware or into the faces of workers. The automatic shut-off types such as are shown in Figure 3 close tight and may be laid down or dropped without danger of reopening or bending the valve stem. Furthermore, the blast from this type of air-gun is under constant one-hand control, leaving the other hand free.

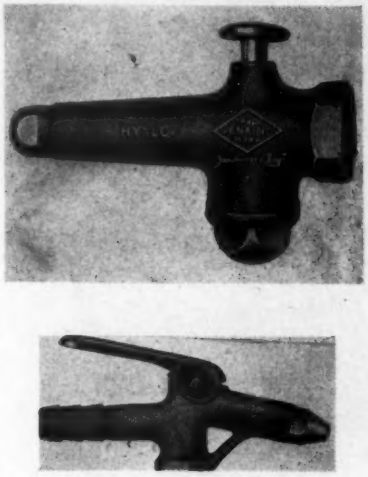


Fig. 3. Two types of automatic air-guns.
Top—Jenkins
Bottom—Lunkenheimer

Air-guns, regardless of the type, are also a source of much misuse of compressed air. While glass forming machines should be kept clean by periodic "blow-offs" many operators carry the blowing off operation to extremes by the too frequent use of the air-gun. Much air can be saved by the adoption of systematic machine cleaning periods. The use of the air-gun for removing water, dirt and the like from the floor when other methods would do just as good a job (but require more elbow grease), is also a common practice and it is obvious that much air can be wasted in this manner.

The common practice of blowing air lines to free them of water or condensate should be avoided because it results in an appreciable loss of air. Instead, lines in which water is known to collect should be provided with separators. These need not be elaborate; a piece of pipe about four inches in diameter and two feet long at the end of a feed line may suffice. The inlet should extend through and about six inches from the top of the separator, and the outlet to the hose manifold should be at its highest point. The trap must be drained from the bottom as often as is found necessary. The frequency with which this is done will depend to some extent on the weather.

The air losses which have been discussed are common ones and a trip around the average plant will doubtless reveal other sources of air wastage that can be easily remedied and which will result, when corrected, in appreciable savings in the cost of the compressed air.

FRED A. CONKLE MANAGER OF DISTRIBUTOR SALES AT WYANDOTTE CHEMICALS

Wyandotte Chemicals Corporation has appointed Fred A. Conkle manager of their Distributor Sales Departments of both the J. B. Ford and Michigan Alkali Divisions. Mr. Conkle comes to Wyandotte from the William Lynn Chemical Company, Inc., of Indianapolis, with which company he has been associated since 1940.

Mr. Conkle has sold road and materials handling machinery, and before joining Lynn Chemical he was sales manager for a rock asphalt firm. Although he will now be located at Wyandotte, Mr. Conkle will spend a great deal of his time with the distributors of Wyandotte Chemicals.

TWO PERSONNEL PROMOTIONS ANNOUNCED BY THATCHER MANUFACTURING COMPANY

According to a recent announcement by the Thatcher Manufacturing Company, Herbert C. Abrahamson has been promoted to sales manager of the General Line Division, and John R. Allen has been selected to take over the sales for the company in Mr. Abrahamson's former territory, the New England states.

Mr. Abrahamson, who has been with Thatcher for eight years, will have his headquarters at the company's main office in Elmira, New York, and Mr. Allen will be located in Boston. Mr. Allen has been in Thatcher's employ for the past seven years.

PLASTICS COMPANY PURCHASED BY LIBBEY-OWENS-FORD

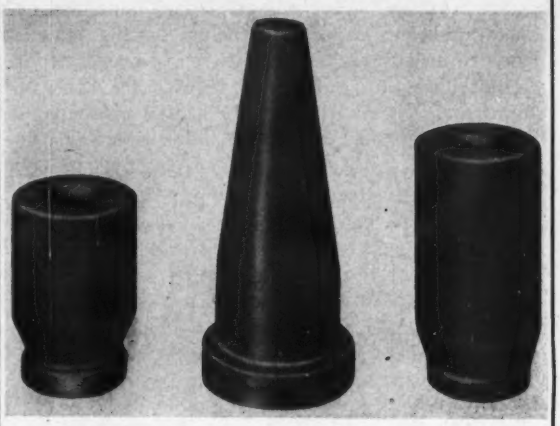
Libbey-Owens-Ford Glass Company is further expanding into the field of plastic resins through the acquisition of the Paramet Chemical Corporation located in Long Island City, New York. Libbey-Owens-Ford formed a wholly-owned subsidiary known as Paramet Corporation, which purchased the physical assets, patents and good will of the chemical corporation.

Last year Libbey-Owens-Ford purchased the Plaskon Company, Inc., a manufacturer of synthetic resin molding compounds and adhesives and set it up as a division of L-O-F. The new company, Paramet, will maintain autonomy so far as possible, operating as an adjunct of the Plaskon division.

Paramet manufactures alkyd resins, phenolic resins, modified phenolic resins and ester gums. To this line of products will be added the urea formaldehyde resins made by Plaskon.

• The Cambridge Wire Cloth Company, Cambridge, Maryland, recently appointed Mr. J. W. Workinger as their St. Louis Field Engineer. He will be in charge of the company's new office in St. Louis, Missouri.

Gunite A-CCA For Moulds



GUNITE bottle moulds will reduce your production costs for GUNITE metal has the right hardness to facilitate easy machining and the right density to assure a metal which will take a brilliant polish. GUNITE has excellent thermo-conductivity, resistance to heat fatigue, freedom from foundry defects and an unusually long life.
Gunite Foundries has developed a metal for every type of glasshouse castings. Miller plungers and guide rings, neck ring sticks, bushing stock, press and blow moulds. Write us today

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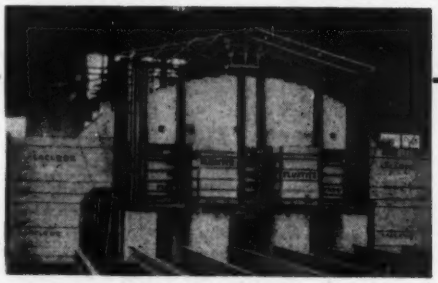


Complete Installations for Bottle Plants
Complete Installations for Window Glass
Complete Installations for Tableware Plants
Glass Melting Tanks and Furnaces
Refractory Materials—All Kinds and Shapes
Blocks—Fire Bricks—Prepared Pot Clay
Automatic Forming Machines
Automatic Feeders
Automatic Glass Tubing Machines
Lehrs-Annealing and Decorating
Installations Built to Suit Conditions Abroad

IF IT IS FOR THE GLASS INDUSTRY CONSULT US

General Glass Equipment Company
ATLANTIC COUNTY TRUST BUILDING
ATLANTIC CITY, N. J., U.S.A.

REDUCING ABSENTEEISM . . .

(*Continued from page* 66)

cessive drinking by company employees stops, will make the tavern-keeper think twice before serving too many drinks to men from the plant. Investigation of "Monday sickness" has also shown that keeping the bank open one evening a week gives the workers a chance to cash their checks in some other place than the tavern.

Visits to dentist, doctor, hairdresser or barber are frequently cited as reasons for taking a day off. Management used to be impatient over such answers, but there is much to be said for the workers' case in communities where so many doctors and dentists have joined the armed forces, and where the few barber and beauty shops are closed in the evening. Where plants run continuously, and there is not enough rotation of shifts, night workers stay away now and then to see a movie or to enjoy some other diversion not commonly available before dark. Where both husband and wife are employed, and their shifts are not synchronized, they may both "take off" in sheer desperation.

Institute surveys prove that women are absent from their jobs more frequently than men. In some cases, the absentee rate of women is 40 percent higher than that of the men. Of course, much of this is caused by the difficulty of holding a job and keeping house at the same time. One of the leading causes of absenteeism among women workers is shopping for the family. This rate can be reduced by prevailing on the merchants to keep open on certain evenings.

Long Working Hours Hurt Attendance

A direct relation has been found between absenteeism and hours of work. When they have excessive overtime at time-and-a-half pay, workers are apt to take occasional days off. The most wholesome working schedule—from the viewpoint of production as well as from that of attendance—is 48 hours a week. Experience in a diversity of fields has shown that if working hours are cut to 48 per week, the absenteeism rate goes down as much as 20 to 30 percent.

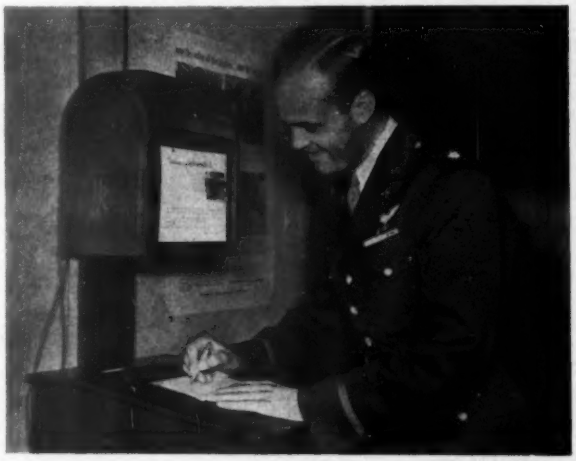
A frequent cause of absenteeism is taking time off to look for another job. Many a worker who is about to "make a change" can be shown that his net gain from the shift may turn out to be smaller than he expects. Changing jobs may mean moving to another locality, which may not have equally good schools or housing facilities. Post-war employment is another factor: the glass industry's conversion problem is small compared with many others'. It does not harm to help the worker to distinguish the substance from the shadow.

Exit Interviews Reduce Turnover

Discussions of the type referred to above imply the existence of an opportunity for a meeting between the worker who is quitting and some responsible company executive, preferably the personnel manager or industrial relations director. Since it is human nature for the worker to want to slip away as inconspicuously as possible, some automatic machinery must be set up to insure the contact. The Labor Relations Institute recommends that this be done through the simple means of requiring the employee to pick up his final pay envelope at the personnel department from a designated official, instead of at the cashier's window. Then management will then have a last-ditch opportunity to dissuade the worker from quitting—and also to discover what is underlying the decision to quit.

Workers who have made up their minds to take a different job are more apt to speak frankly of their reasons for taking the step. Causes which even the absentee reports did not reveal may come to light during the interview. That is why the so-called "exit interview" is acknowledged to be a major weapon in the reduction of turnover.

Briefly stated, employees usually are absent without excuse because of conditions—either inside the plant or in the community—which can be corrected or ameliorated. They move on to other jobs, generally speaking, because nothing is done to change the situation. An aggressive campaign to remove the underlying causes for dissatisfaction will pay every glass manufacturer handsome dividends in production and employee morale.



Major Ralph F. Schmidt writes a letter to a service man on the letter automat.

LETTER AUTOMAT MAKES SENDING MESSAGES TO SERVICE MEN A SIMPLE MATTER AT OWENS-CORNING

The ingenious device shown above, which has greatly increased the flow of letters from members of the Toledo general offices of Owens-Corning Fiberglas Corporation to former fellow workers now serving with the armed forces, was developed by Philip Linne and Edmund S. Adams of the company's staff.

"The letter automat" consists of a wooden desk across the center of which paper is fed from a roll of ordinary teletype paper. Each roll provides for a group letter to a service man and may contain anywhere from a dozen to over forty individual messages.

Each day a different service man is designated to receive a letter. As each writer finishes his message he turns a crank at the side of the desk, rolling the written matter onto a roller within the desk, and bringing up a clean section of paper for the next writer. At the end of the day the roll of messages is taken from the desk and mailed.

KETTLE OF TROUBLE?

Let's look into it!

LOTS of things cause you trouble today. Most of them stem from three things — scarce materials, lack of manpower, and the demand for rush deliveries.

Some of these problems we can't help you solve. But there are several important ways in which Du Pont Ceramic Service *can* assist you. Du Pont research facilities and technical experience are available to help you in selecting the proper substitutes . . . to give advice on the latest technique in color application. We volunteer all the aid we can give. Write, 'phone or wire: Technical Service, Electrochemicals Department, E. I. du Pont de Nemours & Co., (Inc.), Wilmington, Delaware.

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***for* CERAMICS *and* GLASS**

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BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

PAGE 2 - MORGAN CONSTRUCTION CO. TO [illegible] DATE 2 January 1946

operation of the system is controlled by the flow of air from the blowers and is not dependent upon the temperature of the gases removed. Obviously, the temperature of the stack and the state of the weather have no effect whatsoever upon the operation of this system.

Hot gases do not pass through the fans but are carried up the short Venturi stack by induced draft. They are mixed with cold air before reaching the valve located in the throat of the ejector: this valve, therefore, is not subject to violent expansion, and remains tight when closed.

The strong push and pull action of the two fans permits the use of extra regenerator chambers which retain a greater proportion of the heat of the gases, and insure higher temperature air delivered at the combustion ports. High capacity regenerators reduce to a minimum the temperature change during a reversal, and the forced air practically eliminates changes in volume. Fully automatic controls can be set for any desired cycle.

I might also mention the fact that the Morgan Isley System requires less steel than needed for a tall stack installation.

Very truly yours,
MORGAN CONSTRUCTION COMPANY

V-44

CANADA'S CONTAINER PRODUCTION FOLLOWS GENERAL PATTERN OF UNITED STATES

T. W. Bassett, vice president and general manager of Dominion Glass Co., Ltd., of Montreal, Canada, recently reported that the war demand has offset a decline in domestic glass production and the industry holds at a high level. Some of Mr. Bassett's comments from his annual review follow:

"Volume in the Canadian glass container industry during the year 1943 continued at a high level, as in the preceding year. Government wartime restrictions affected domestic demands, particularly from the beverage trades. On the other hand, a large tonnage of glass was supplied for military purposes under government direction and there is every indication that these requirements will continue during 1944.

"Due to restrictions in the use of tin plate many manufacturers of products formerly packed in tin were advised by the authorities to use glass containers where no other suitable substitute could be found. As the importance of many of these products to the community was recognized, the glass industry, at the request of the Glass Administration of the Wartime Prices and Trade Board, supplied the various trades involved with a proportion of their requirements. The variety of these products for which glass substitution was made may be gleaned by mention of a few of them, as follows: corn syrup, paint, anti-freeze, hand cleaner, insecticide, edible oil, health salt, baby food, liquid wax, motor oil, metal polish, tooth powder and fish.

"Publicity given to the need for food conservation as part of the war effort resulted in a heavy increase in home canning by Canadian housewives. The increased volume of preserving jars required to meet this demand, although abnormal, was provided.

"A study of glass container designs, with a view to simplifications and conservation of glass tonnage and metal used in closures, was undertaken at the request of the Glass Administration of the Wartime Prices and Trade Board. Resulting from this study and after consultation with the advisory committees of the industries affected, regulations were put into effect by order-in-council limiting sizes and shapes to be used for specific products. A great many existing designs were eliminated for the duration by this standardization program. In food jars, for example, the number was reduced from approximately 200 different shapes and sizes to nine. As these standardized containers were designed to obtain filling capacity with minimum weight of glass and took the place of heavier jars, it enabled the glass manufacturer to supply a considerably greater quantity of containers per ton of glass.

"No serious difficulties were encountered in securing the main, essential materials used in the industry. Shortages did develop in supplies of lesser importance, which caused some inconvenience and difficulty, but did not affect production. The scarcity of help, however, prevented the maximum use of available furnace capacity.

"In addition to supplying glass products in large volume, the industry continued to produce metal parts for war munitions to its available capacity."

NEW PRODUCT OFFERED BY B. F. GOODRICH COMPANY

The Chemical Division of The B. F. Goodrich Company announces that it has chosen the name GEON for a group of unique polyvinyl resins which it has developed and is now offering to industrial users. The name, GEON, from the root word geo (the earth), was chosen because the basic raw materials from which these polymers are derived have mineral origin.

Two of the resins, GEON 202 and GEON 203, are entirely new vinyl chloride: vinylidene chloride copolymers, different from any others previously developed in this group.

The properties contained in the four GEON resins are listed in the following table:

Geon Number	Specific Gravity	Average Acetone Extract	Average Specific Viscosity*	Recommended % Solids in M.E.K.** @ 20° C.	@ 70° C.	Plasticizer Index***
101	1.41	15%	.55	4.5	12	43
102	1.41	14%	.59	4.5	12	43
202	1.43	48%	.40	8	17	34
203	1.44	56%	.36	14	25	31

* At 20° C. of 0.4% Solution in Nitrobenzene.
** Methyl Ethyl Ketone.
*** Weight of dioctyl phthalate per 100 weights resin to give comparable hardness at room temperature.

• Announcement has been received that the winter meeting of the Optical Society of America will be held at the Hotel Pennsylvania in New York, on March 2-4, 1944. The meeting will be open to non-members as well as members of the Society. All interested persons are cordially invited to attend.

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THE FLOOR OF HEAVEN . . .

(*Continued from page 62*)

condemned it nearly two thousand years before it was invented.

Thus, so far as the English Bible is concerned, the word "glass" includes speculum metal and the tin can; and since this kind of glass is condemned on such high authority, I have no objection to his use of the word.

Now Archimedes, also in very ancient times, is said to have invented the "burning glass," and to have burnt up the enemy ships in the Harbor of Syracuse, Sicily. He probably used quartz; or if not, it is certain that burning glasses have in much more recent times been made of quartz crystal. Any convex lens suitable for starting a fire by forming an image of the sun upon tinder, is a burning "glass," independently of the fact that it may be made of crystalline quartz, or of CR39, or Plaskon, or Lucite.

It seems, therefore, that for literary purposes, a "glass" is anything transparent and hard, like oriental alabaster, or quartz; anything that is reflecting, and hard, like speculum metal or tin-plate; anything that can form an image of the sun, like a concave mirror or a convex lens, whether of quartz, plastic or modern glass; a highly polished floor; and anything cold, inhuman, or dead, like a glassy stare.

It can be crystalline or amorphous, real or metaphorical, metallic or non-metallic, organic or inorganic, crystal-clear or obscuring, a prototype of perfection or a metaphor for imperfection. It is all things to all men. Only those of universal sympathies can appreciate it, only citizens of the world can understand it. It is the word men use when they are completely stumped. It should not be used on other occasions.

*The Song of Moses will be found in Exodus 15.
**The noun is hyalos. John uses the adjectival form, hyaline.
***In parenthesis, we note that the English authorized version says "they stand on the sea with the *harps* of God", which gives the wrong impression to a modern reader; for you cannot *stand* and play a modern concert harp. You have to sit. Therefore the saints do not have harps: what John says is, that they have "kithars", that is "guitars"—it is the same word come down through the ages. So I have once more taken the liberty of amending the English version.

SAFETY MEASURES BROUGHT TO SMALL INDUSTRIAL ORGANIZATIONS

The National Safety Council has inaugurated a new membership service designed exclusively to fit the needs of industrial organizations with 100 employees or less.

A recent survey of organizations of this size, in seven different industries, showed the average accident frequency rate for these organizations actually 47 per cent higher than the average for the largest organizations in the same industries.

Some of the services to be included in this membership are as follows: A safety manual on what management should know about organization and operation of an industrial safety program; monthly poster service with selections made especially for small unit operations; and a full year's subscription to *National Safety News*, the Council's official magazine, which will contain a section devoted exclusively to the problems of this type of member.

Left to right: Bert Cremers, I. H. Taylor, and E. M. Ford.

IRVING H. TAYLOR TO LEAVE WYANDOTTE CHEMICALS CORPORATION

Mr. Irving H. Taylor, former vice president in charge of sales of the Wyandotte Chemicals Corporation has relinquished this position to devote his entire time to the Merchants Chemical Company, of which he is president. Mr. Taylor is well known in the heavy chemicals industry and has been associated for thirty-two years with Wyandotte Chemicals and its predecessor, the Michigan Alkali Company.

At a recent luncheon Mr. E. M. Ford, president of Wyandotte, presented Mr. Taylor with a Commemorative Scroll signed by representatives and executives of the company.

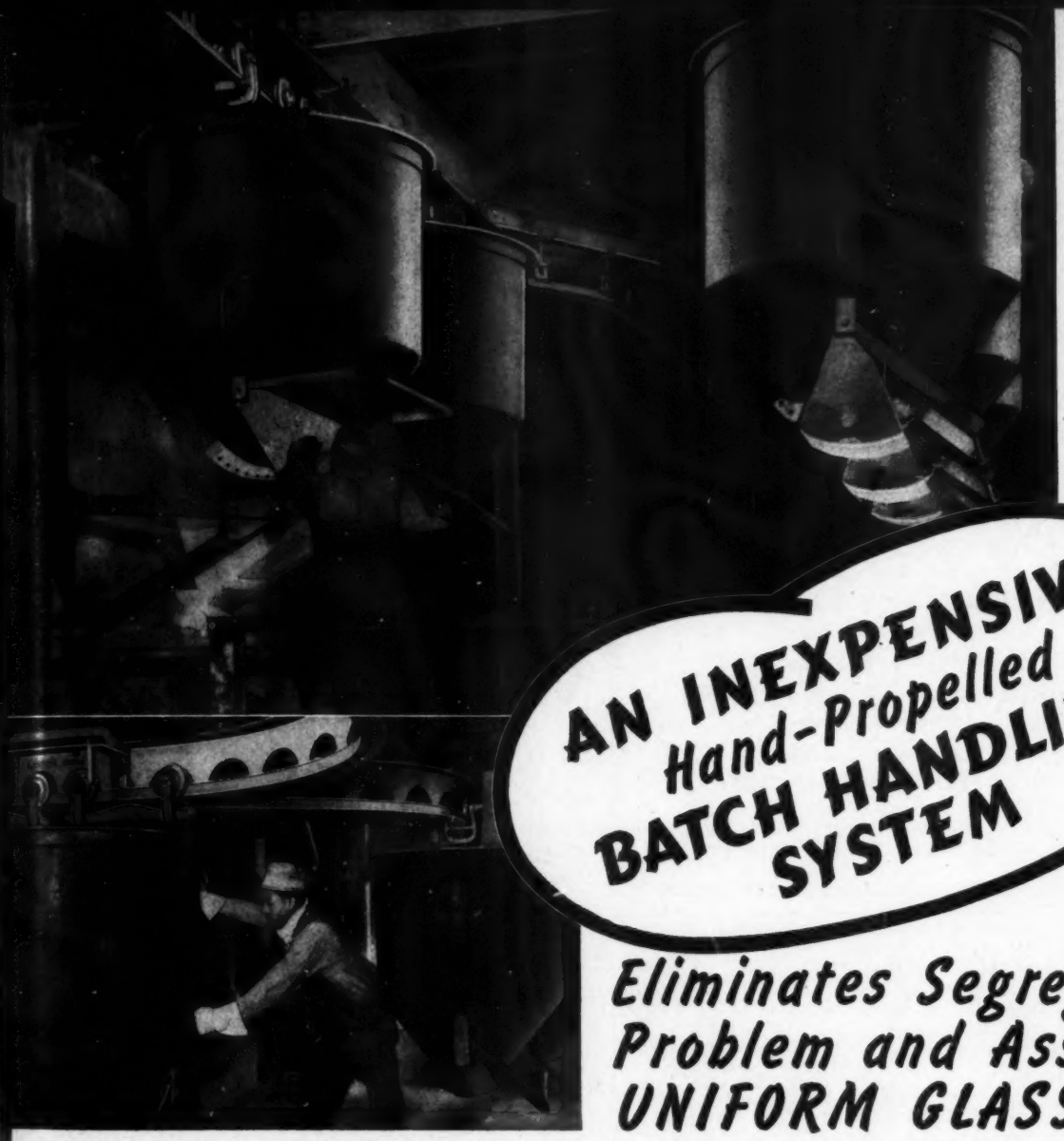
Mr. Bert Cremers will continue as vice president in charge of sales of the Michigan Alkali Company.

NEW EMPLOYEE FOR PENNSYLVANIA SALT

Pennsylvania Salt Manufacturing Company of Philadelphia has announced the acquisition of L. H. Brandt, Ch. E., for their Technical Service Department. Mr. Brandt comes to Pennsylvania Salt from the National Ammonia Division of duPont, which position he held for more than ten years.

During his career Mr. Brandt has been identified with ammonia and other heavy chemical utilization in the fields of refrigeration, oil refining, and heat treating. In his new position with Pennsylvania Salt his services will be principally devoted to rendering assistance to heavy chemical users.

● Word has been received from the Diamond Alkali Company that Mr. Raymond Diaz joined the staff of the Diamond Alkali Sales Corporation on January 1st of this year as Supervisor of District Offices. Mr. Diaz was formerly treasurer of Benner Chemical Company, Chicago.



Illustrated is a Cleveland Tramrail hand-propelled batch-handling system. The operator is discharging the batch at the doghouse.

AN INEXPENSIVE Hand-Propelled BATCH HANDLING SYSTEM

Eliminates Segregation Problem and Assures UNIFORM GLASS!

...ets loaded with batch are easy to ... Because of easy rolling carriers ...nooth Cleveland Tramrail rail, a ... of several buckets can be readily ...ed by one man.

Segregation is just as troublesome in smaller glass plants as in the large ones. It must be eliminated in order to secure steady production of uniform glass.

Small plants usually cannot afford extensive motor-driven batch-handling equipment as required to keep large tonnage producers operating at capacity. For them, however, an inexpensive Cleveland Tramrail hand-propelled system offers a happy solution.

The same principles upon which motor-driven batch-handling systems depend for elimination of segregation are employed for hand-propelled systems. The only difference being that all operations are done by hand. Since Cleveland Tramrail equipment rolls unusually easy, requiring only 15 pounds starting effort and 10 pounds running effort per ton weight, many tons of batch can be moved per hour with reasonable physical effort.

If your plant is small and you wish to produce consistently good glass that is in accordance with the formula at all times, you should investigate the possibilities of a Cleveland Tramrail hand-propelled system.

GET THIS BOOK!

...OKLET No. 2009 . . . Describes glass plants ...g Cleveland Tramrail. Contains engineering ...a and information valuable to glass producers.

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"IF IT'S MADE OF GLASS, ASK US FIRST"

NEW HEAT-TREATED GLASS FOR FOOD DEHYDRATING EQUIPMENT

The Pittsburgh Plate Glass Company announces a new, heat-treated glass for use in dehydrating equipment to take the place of war-time critical metals.

This glass is four times as strong, flexible and tough as ordinary glass of equal thickness, making it more than adequate for any purpose in dehydration operations. It withstands constant temperatures up to 650° F, as well as sudden variations of temperature necessary in certain processes. The new product is absolutely immune to the attacks of practically all food acids, fumes and chemicals.

Because of its great strength, this glass is not a temporary substitute for other materials, but is permanent equipment.

INVENTIONS AND INVENTORS . . .

(*Continued from page* 73)

Preston W. French of Wilkinsburg, Pa., has assigned to Pittsburgh Plate Glass Co. his patent 2,337,460 covering an interesting technical advance in the formation of a non-reflecting film on glass surfaces. In this field it has already been proposed to use suitable coatings of organic materials. Also it has been suggested to leach some of the alkalies from the glass surface to give a more durable film. French combines this step with others which yield a suitable film rich in calcium fluoride and of such a thickness as to reduce reflections. He first treats the surface with nitric or other strong mineral acid to leach out soluble alkalies and leave a film rich in silica and lime; then the surface is treated with a water solution of hydrofluoric acid and a soluble fluoride such as sodium or ammonium fluoride, both in dilute concentration; this solution removes silica and converts the calcium compounds into the desired film of calcium fluoride.

Another patent assigned to Pittsburgh Glass Co. is 2,337,435, the invention of F. W. Adams covering apparatus for grinding and polishing plate glass.

OFFICERS ELECTED AT AMERICAN WIRE FABRICS

The Board of Directors of the American Wire Fabrics Corporation, a subsidiary of the Wickwire Spencer Steel Company, recently elected the following officers: L. D. Granger as vice president; George H. Creveling as treasurer, and Franklin Berwin as secretary.

Mr. Granger has long been associated with American Wire Fabrics and is considered an outstanding steel metallurgist and engineer. Mr. Creveling also holds the position of treasurer with the parent company Wickwire Spencer Steel and another subsidiary, the Wickwire Spencer Aviation Corporation. The newly elected secretary, Mr. Berwin, is also a member of the Board and secretary of the parent company.

DRAFTSMAN

WANTED: By established West Coast plant. Must be capable of making mold equipment layout for Lynch and I. S. Machines. State experience, references, and draft status. Address Box 75, The Glass Industry, 55 West 42nd Street, New York 18, N. Y.

WANTED: Mechanical Engineer experienced with automatic table-glass machines—Blown and Pressed. Satisfactory salary assured. Excellent opportunity. Immediate consideration on application. Address Box 79, The Glass Industry, 55 West 42nd Street, New York 18, N. Y.

LEHR WANTED

Small and narrow annealing lehr wanted for gas or electrical operation; overall length about 30-40 ft.; temperature range 1250° F maximum and approximately 600° F minimum. Advise full details, including origin, age and condition. Address Box 80, The Glass Industry, 55 West 42nd Street, New York, 18, N. Y.

FOR SALE: Model 44 O'Neill Machine complete with molds for quart stubby and quart home canning jars. Address Box 76, The Glass Industry, 55 West 42nd Street, New York 18, N. Y.

NEW GENERAL LAMP SALES MANAGER AT WESTINGHOUSE

William J. Massey has recently been appointed general lamp sales manager of the Westinghouse Lamp Division with headquarters in Bloomfield, New Jersey, according to a recent news release from the company. In this position he will have charge of all lamp sales activities of the Lamp Division including district sales offices; the illuminating engineering; commercial engineering and advertising departments.

Mr. Massey has been associated with the commercial activities of the Lamp Division since 1907.

AMERICAN GAS ASSOCIATION WAR CONFERENCE TO BE HELD IN ROCHESTER

It has just been announced that the 1944 American Gas Association War Conference on Industrial and Commercial Gas will be held on March 30 and 31 at the Hotel Seneca in Rochester, N. Y.

The three-fold objective of the Conference is: (1) to study equipment and practices in gas utilization in war production plants and military camps and bases so that improvements can be applied wherever they will help the war effort; (2) to study the requirements of altering or replacing old industrial gas equipment in war plants and to rehabilitate commercial equipment during the coming reconversion period; and (3) to plan for maximum industrial and commercial gas and equipment sales in the post-war period.

This Conference alternates yearly between natural and manufactured territories. The program is nicely balanced to include subjects that are of interest to both natural gas and manufactured gas men and equipment manufacturers in the industrial and commercial field.

GLASS STANDARDS FOR FLUOROMETRIC DETERMINATIONS

The Scientific Bureau of the Bausch and Lomb Optical Company, which has studied and selected several types of optical and ophthalmic glass which supply reliable reproducible values, has just proposed the substitution of fluorescent glass standards to replace chemical solutions used for the calibration of fluorometric instruments.

The company has developed particular types of glass which are suitable for standards in the fluorometric determination of vitamin B_1 and vitamin B_2. Made in the form of blocks, these glass standards will replace the liquid filter holders normally used for standard solutions.

Once a standard has been properly set up and calibrated by accurately known solutions and under prescribed working conditions, it will serve as a permanent secondary working standard against which a particular instrument may be quickly and easily checked.

GLASS INSPECTION
with the *Polaroid*

Spectacle type polariscope

THE polarizing spectacle, mounted in unit with sensitive tint plate of 565 millimicrons, presents an absolutely uniform field of large aperture, strains showing up in sharply defined and correct colors.

Standard size apertures are 6" diameter and 12" diameter, and a rectangular size of 8" x 16"; but any special size to meet your requirement can be made. The 6" unit is suggested for either plant inspection uses or—as a portable unit for the trouble shooter or the salesman where a large aperture, compact unit of light weight is desirable.

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